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NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

A DESIGN FOR AN INTERACTIVE VIDEODISC TRAINING PROGRAM FOR THE SUN WORKSTATION

by

Roger Eric Kaplan
and
David Lester Walts

March 1984

Thesis Advisor: G. A. Rahe

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A Design for an Interactive Videodisc Training Program for the Sun Workstation

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN INFORMATION SYSTEMS

from the

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ABSTRACT

The demands on the military operational decision maker because of the ever-increasing tempo of developing crises, and the explosion of information available, require the development of decision aids. The availability of powerful microcomputers with sophisticated input and output devices and networking capabilities makes the development of a command and control (C^2) workstation possible. However, such a system will be virtually useless if it is not easy to learn and simple to use. This thesis examines current videodisc and computer assisted instruction technology for their potential usefulness to the U. S. Navy. The videodisc, with 54,000 addressable frames, can provide help functions during operations which overlay computer response with the desired response. This will result in an effective system which is easy to learn, easy to use, and easily customized by the user. The study proposes a design by which the potential of interactive videodisc technology can be realized in the auto-instructional mode for the Sun Workstation.

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I. INTRODUCTION

As more and more sophisticated computers with specialized applications become available, the difficulty of training the users to operate this equipment also increases. The sophisticated computers also lend themselves to much more advanced automated teaching aids than previously developed. One such aid is the interactive videodisc.

One of the highest priorities in the Department of Defense is the efficient use of manpower. One way to improve manpower efficiency is to increase the productivity of personnel in the execution of their tasks. Another way is to raise the level at which apparently unqualified personnel are employed. This critical manpower requirement is met in part by utilizing computers to simplify and expedite the performance of both routine and complex tasks. However, computer systems do not function of their own accord. Only personnel trained to operate computers can achieve maximum efficiency with them. The first step in solving the manpower problem is to establish auto-instructional methods and materials.

Another concern of the military is that decisions be based on the best available information evaluated with sound decision-making processes. The demands on the military operational decision maker due to the ever increasing tempo

of developing crises, and the explosion of information available, require the development of decision aids. The availability of powerful microcomputers with sophisticated input and output devices and networking capabilities makes the development of a Command and Control (C^2) Workstation possible. However, such a system will be virtually useless if it is not both easy to learn and simple to use.

The primary objective of this thesis is to propose a design by which the potential of interactive videodisc technology can be realized in the auto-instructional mode of a workstation. The videodisc, with 54,000 addressable frames, can provide help functions during operation which overlay user response with the desired response. This design will result in:

1) A highly efficient and effective system;
2) A system easy to learn;
3) A system easy to use; and,
4) A system customized to the user, a personal decision aid.

The design of videodisc courseware is the subject of this thesis. The development and use of videodiscs and computer assisted instruction (CAI) are reviewed as background for an examination of a particular videodisc intructional system. Chapter Five of this thesis presents the tenets of interactive videodisc design. These are implemented in Chapter Six in a design proposal for an

interactive videodisc training program for the Sun Workstation. This study concludes with recommendations for the implementation of the design.

II. VIDEODISC TECHNOLOGY

A. HISTORY

When Thomas Edison first recorded and played a human voice on a wax cylinder in 1877, it was only a matter of time until someone developed a means to record visual material as well. E. Berliner of Germany developed a wax disc for voice recording in 1889, but the first videodisc did not appear until 1927. That year J. T. Baird demonstrated his "Phonevision" system in England. It was a wax disc played by optical scanner. In 1935, Baird Radiovision (six minutes of video) was marketed in London's Selfridges. The next development was Westinghouse's "Phonovid." Produced in 1965, this disc contained and played back single frames [Ref. 1: p. 1].

Further research in the next several years investigated a variety of methods for disc creation and playback. Experiments were made with grooved discs played by an electric stylus, incandescent bulbs "reading" photo-film discs, and laser effects on metallic films. The experiments led to a distinction between videodiscs for video information, and optical discs for digital data. The optical discs require and provide greater precision and error control than videodiscs. In 1972, MCA introduced its Disco-Vision system which utilizes a laser beam to "read" pitted reflective

discs similar to standard phonograph records. The first institutional and government videodisc systems were delivered in 1976-77; MCA marketed a consumer videodisc system in cooperation with Magnavox in 1978; and Pioneer introduced its consumer videodisc player in 1980.

Videodiscs became widely known to the general public in 1981 with RCA's highly publicized Selecta Vision. Initially demonstrated in 1975, the Selecta Vision was essentially a movie in the physical form of a phonograph record played by a capacitive stylus. It offered high fidelity stereo sound and high resolution pictures but seemed to be little more than an improvement in the quality of playback of recorded motion. Its ability to engage the user more deeply than the average cartoon or situation comedy was limited. The user was simply a passive viewer.

Laser videodiscs are made with an entirely different "record" and playback process. They have seemingly endless possibilities for random access, user interaction, information storage and retrieval, and practical applications. The factor responsible for altering the potential of the videodisc concept is imaginative design.

B. VIDEODISC AND VIDEODISC PLAYER CONSTRUCTION

The RCA Selecta Vision disc is created in a manner similar to that used for creating phonograph records. The recording process produces a grooved disc which is played

using a mechanical stylus which resembles a phonograph stylus. The disc has two audio channels available. In its original conception and applications, the Selecta Vision package produced only linear action (moving directly from the beginning through the middle to the end). However, recent developments by RCA include random access capability, viewer options, memory start, and a 30-function infrared remote control unit [Ref. 2].

The laser videodisc at present far surpasses the capabilities of the Selecta Vision system. A laser videodisc has a capacity of 54,000 frames per side, or 30 minutes of video if played straight through. The advantage of the laser videodisc is that it need not be played straight through. The laser system in combination with an onboard microprocessor or an external computer allows for random access, with average retrieval of one to three seconds, or the new "instant jump" feature which permits changing from one segment to another without pause [Ref. 3]. The laser videodisc also has two audio channels.

A laser videodisc or optical disc may be made in one of several ways. Basically, a laser beam receives information from a video or digital signal and "writes" it on a disc by distorting thin metal films or fibers on a glass master. The process may involve burning holes or raising bubbles in a metal film, or changing the index of reflectivity of fibers [Ref. 4: p. 87]. The disc is then permanently

sealed in transparent plastic to protect the fragile surface. This directly encoded disc is used as a master from which any number of copies may be produced.

The laser optical or videodisc player uses a low-power laser beam which is reflected at intervals to display data or images on screen. The size and position of the hole, blister, or mark relative to others on the disc may encode information [Ref. 4: p. 87]. Another method uses the distance between marks and the diameter of marks to create pulse-width encoding which produces a video signal [Ref. 5: p. 863] The Thompson CSF Videodisc system transmits information when the laser beam passes through a transparent, nonreflecting disc.

The material to be encoded on a videodisc must originate on a videotape or film. The videotape must be a two-inch helical type for the Disco Vision Associates photosensitive process [Ref. 5: p. 862]. 3-M reports that the best video resolution results are obtained from motion picture film shot at 30 frames per second [Ref. 6: p. 54]. 3-M also offers rapid production of videodiscs from videotapes in either 3/4-inch U-matics or one-inch type C format [Ref. 7].

C. OPTICAL DISCS AND VIDEODISCS VS. MAGNETIC MEDIA

Optical discs and videodiscs are capable of storing sound, video, graphic, or digital information. Magnetic

media have the same capability, but there are many differences.

Optical discs and videodiscs are durable and easy to handle, in contrast to magnetic media. All optical or videodiscs are removable from the player or drive, unlike most high-capacity magnetic discs (hard discs). Due to their heavy plastic coatings, video and optical discs are not susceptible to damage from fingerprints, magnetic fields, and dust. Magnetic media, on the other hand, are easily damaged by any one of these. Additionally, video and optical discs are much more resistant to damage by heat and humidity.

The issue of capacity relative to space clearly demonstrates the superiority of the video or optical disc. One disc generally has up to 100 times the storage capacity of the same size magnetic media. Thus, it provides storage at a small fraction of the cost per user-byte for magnetic media. Capacities currently available in videodiscs are 54,000 frames per side or from 1.25 to 4 gigabytes of digital information on an optical disc (a gigabyte equals 1024 megabytes) [Ref. 4: p. 90]. The reliability of video and optical discs is an asset but initially the permanence appeared to be a drawback. Disc technology at present precludes erasability of videodiscs, unlike magnetic media which may be erased, altered, or updated easily whenever desired. However, the optical disc is now perceived as a

different level in the hierarchy of data storage and retrieval. An optical disc is well-suited to archival and long-term storage applications in which erasability is frequently undesirable. Some researchers feel it would be possible, and even desirable, to place a label on obsolete material with a pointer to updated information. In this way, original data is always preserved for historical and audit purposes [Ref. 4: p. 90]. Research is underway to develop erasable and reusable optic media. Magneto-optic materials and phase change erasable techniques are being studied [Ref. 4: p. 90].

Optical discs for digital and image information storage appear capable of achieving comparable and even superior corrected bit error rates (BER). The uncorrected BER of optical media is generally one in 10^6. Error detection and correction (EDAC) techniques can improve this to a corrected BER of one in 10^{13}, although as much as 50 percent of the disc's capacity is used in the process. Storage Technology Corporation has announced achievement of a corrected BER of one in 10^{13} requiring only 20 to 30 percent of a disc. [Ref. 4: p. 92]

Both video and optical discs produce high-resolution images not possible with magnetic media. This may appear to be an insignificant advantage or even a useless attribute until one considers training and educational applications. Full-resolution images can prove significant when training

requires presentation and study of clear pictures of detailed drawings or complex machinery. Clear, crisp pictures can also affect the intangible aspect of viewer or user interest and impact. A good, clear picture is more interesting and engaging than a fuzzy one of the same subject. One of the generally accepted theories of education is that learning is best achieved when the learner is interested and engaged in an active manner in the process [Ref. 8: p. 4]. A high-resolution image may interest the user, but another facet, interaction, is necessary to actually engage him in the process.

D. LINEAR VS. INTERACTIVE PROGRAM FORMATS

Our standard educational formats involve passive absorption of knowledge by the student. Lectures, textbooks, educational television programs, films, and filmstrips generally require no more involvement from the student than listening attentively and perhaps taking notes. There are few demands (excluding science experiments) placed on the student to actively participate in acquiring and internalizing the knowledge by experimenting, solving problems, building models, and experiencing situations [Ref. 8: pp. 5-6]. In most cases facts are taught without ever teaching students the process of discovering facts from observable evidence or using previously acquired knowledge to make informed decisions or create new material.

Early uses of the computer in classrooms did little more than replace paper and pencil for tests and problem-solving. Videotapes designed for classroom use were (and still are) usually linear lectures. These are even worse than live lectures because there is no direct contact between lecturer and student. There is no opportunity for the student to question the lecturer, and no opportunity for the lecturer to adapt his material to the needs of the students as he goes along.

The stylus-grooved videodisc boasts improved fidelity but does not meet any educational needs that are not already filled by films and videotapes. Recent advances by RCA may alter the situation [Ref. 9]. From the beginning, the laser videodisc was designed to provide random access to information by coupling the videodisc player with an on-board microprocesssor or an external computer. This feature alone makes the laser videodisc the medium best-suited to engage the user in the learning process through interaction. David Hon has proposed five levels of interactivity and related technical demands [Ref. 10]. Level Five is the simplest form of interaction in which a microcomputer is used minimally--if at all--for simple start, stop, or pause commands. Level Four uses recognition questions and other branching which can make existing video programming somewhat interactive. For example, an existing linear videodisc program is divided into segments followed by a review question. An

incorrect answer results in a replay of the pertinent segment.

At Level Three the program can pattern the learning process to the needs of each user by using sophisticated branching, judgment progressions, and "tracks" built on evaluation of student responses. This is possible because the video branches and computer program are designed together for a single purpose or project.

Level Two introduces the use of peripherals to make the program easier to use. A light pen, touch screen, graphics tablet, or voice recognition system, or combination of these, may be added to facilitate the use of specially designed software. This is especially worthwhile when the program is designed to meet the needs of users with widely different backgrounds.

The highest level, Level One, involves the creation of special peripherals for specific purposes in a particular project. For example, an interactive training program for mechanics might require a specially-designed engine with sensors on all the parts to detect correct placement.

The most important factor in the creation of interactive videodisc programs is imaginative, innovative design based on sound research. The research must identify the specific needs or goals of training, the best means to fill the need or achieve the goals, and an appropriate method of evaluation. The complete program design requires the skills of

researchers, educators, computer programmers, video technicians, authors, artists, actors, and sound technicians to produce the most effective interactive videodisc possible.

E. CURRENT INTERACTIVE VIDEODISC SYSTEMS

The test of any theory or technology is to examine it and its applications in the real world. This is also true in the case of interactive videodisc systems. Until a specific system is created to meet a specific need and used by people with that need there is no way to evaluate the effectiveness of good system design. From a larger perspective there is only one way to solve the fundamental question, "Can interactive videodiscs truly provide effective, engaging education producing measurable results?" A specific system for a given situation must be devised and tested.

1. The Information System

Bell Laboratories recently developed an interactive video information terminal designed to give the general public pictorial, audio, and textual information about a city. The system employs a touch-sensitive screen which eliminates the use of numeric or alphanumeric keyboards or even buttons. A hidden speaker and microphone provide audio information and support a speaker phone interface to the television network. [Ref. 11]

The system operates when a user asks for assistance. Menus specify broad classifications of information which eventually narrow down to the specific information required. The user simply touches the screen at the point, line, or object he chooses and an infrared beam detects the choice. Within one to three seconds, the information is retrieved and displayed.

Some information changes so rapidly that a videodisc would become outdated rather quickly. For this reason, the system includes a graphics overlay device to record and display information on transportation schedules, prices, and reservation availability. This is displayed simultaneously with the appropriate video information. It may be updated easily, quickly, and frequently.

The telephone offers the added feature of automatic dialing to enable the user to talk to any establishment about reservations, for example. The minicomputer is activated merely by pointing to the screen. The user need not know the telephone number of the establishment. This videodisc system greatly enhances user understanding of directions about the city.

One important feature of the videodisc system which the information system exploits is the two audio channel capability. Instead of using the two channels for stereo sound, as in most applications, the city information system uses each channel separately. Audio information is provided

in two languages, English and Spanish, one on each channel. When the system is activated, the user is given the opportunity to choose the language of his choice. This makes the system available to many more visitors, without causing anxiety for the non-English speaking individual.

2. Interactive Videodisc CPR Instruction

Cardio-pulmonary resuscitation (CPR) has for years been taught by instructors equipped with a manikin known as "Resusci-Annie." The manikin was frequently equipped with gauges to aid the students and teachers in evaluating the effectiveness of their respective efforts. The system was good but it could not guarantee the same quality of instruction for all students. Nor could it guarantee that all students received exactly the same, precisely correct information.

A new interactive videodisc system developed by David Hon of the American Heart Association incorporates the best aspects of previous CPR training programs in one teaching unit. To accomplish this feat, Hon had to develop peripheral equipment designed to measure the students' effect on Resusci-Annie. In this case, special sensors measure the depth of CPR compressions and monitor the placement of the hands for the compressions. [Ref. 12: p. 12]

The program begins with an introduction by a doctor with several graphics of body locations essential to successful CPR. There are short review questions interspersed

throughout which the user answers with a light pen. Even essay-type answers are possible using an alphabet grid to spell out answers.

The computer monitors student success and automatically reviews segments if necessary. The student also has the option to call up a menu which includes a glossary of still video frames. There are even three levels available (beginning, intermediate, and "technically inclined") [Ref. 12: p. 12].

The final stage of the program involves the highest level of interactivity with actual simulation of CPR on a manikin. The student receives coaching from the on-screen doctor as if he were there. Branching techniques use the sensors in the manikin to identify the difficulties or successes of the student and access appropriate advice and instruction segments that may be only 10 to 20 seconds in length [Ref. 12: p. 13]. It is here that David Hon's imagination is most apparent as the effect of the sensors and such responses as "a little more gently, this time," is to make the student more aware of the victim and his point of view.

The course runs approximately two and a half hours although it is contained on a 30-minute videodisc. This is possible because a large portion of the program is delivered in still frames [Ref. 13]. It is also possible for the course to run much longer or slightly shorter to fit the

needs of the student. The system uses the two available soundtracks to give the option of learning in either English or Spanish. Most importantly, the course ensures that CPR training is standardized, and that no one passes the course until he or she is truly ready.

3. Other Videodisc Systems

The Architecture Machine Group at M.I.T. has created a "movie map" of Aspen, Colorado, using a touch-sensitive screen. They have recently received orders from the U.S. Navy to develop a "visual toolbox" to aid in the repair of complex hardware [Ref. 14]. Bank of America introduced an interactive training videodisc for bank tellers called "People Skills" in 1982, and Walt Disney's Epcot Center in Orlando, Florida is extensively supported by interactive videodisc systems [Ref. 1: pp. 7-8]. The videodisc's potential as a training and educational tool has barely begun to be realized.

F. THE FUTURE FOR VIDEODISC TECHNOLOGY

While it would be impossible to predict with accuracy all the advances that will be made in videodisc technology, some advances can be expected to answer our current needs. The interactive videodisc industry seems likely to develop more running time or more random accessible time on the videodisc, more reliability, smaller-sized units, and higher quality for less cost. Still-frame audio would be desirable

and will probably be available soon. Easier user interfaces, with wider use of peripherals such as touch screens, light pens, and voice activators, are also to be expected in the near future. [Ref. 15]

Some factors will remain essentially the same. A good videodisc system will still depend on a high-quality effective design and master. The needs of the real world will determine the research and development of software and hardware [Ref. 15: p. 9]. Further, each technological advance will most likely spawn new uses for the videodisc system and new areas of training, such as pre-experiencing, which is teaching something to a person before he is exposed to it in real life [Ref. 16]. An example of pre-experiencing would be like teaching the Officer of the Deck of a ship the landmarks of a strange harbor before he actually pilots the ship into that harbor.

To overlook the interactive videodisc for training purposes would be like ignoring textbooks, paper, pencils, and even teachers as potential training aids. The interactive videodisc will almost certainly be in the classroom of the future.

III. COMPUTER ASSISTED INSTRUCTION

A. DEFINITION

The design for an interactive videodisc training program must be based on a study of not only videodisc technology but also computer assisted instruction (CAI). CAI is the direct use of the computer to facilitate learning. This is done in two phases. The first phase uses the computer to make learning easier and more likely to occur. The second uses the computer to provide a record of the actual learning that has occurred.

> CAI is the direct use of the computer for the facilitation and certification of learning--that is using the computer to make learning easier and more likely to occur (facilitation), as well as using the computer to create a record proving that learning has occurred (certification). [Ref. 17: p. 16]

Two categories of CAI are "tutorial" and "drill and practice." Tutorial presents material to be read by a student at the terminal. This is accompanied by periodic questions or problems. The student's responses are recorded by the computer which usually tracks the progress of the student. Drill and practice is the electronic equivalent of flashcards as used in elementary school for math tables and vocabulary.

B. HISTORY

The groundwork for CAI was laid in 1926 when programmed instruction first appeared. This early system was implemented on a simple mechanical device. It posed multiple choice questions to the student and would not advance to the next question until the current question had been answered correctly.

Interest was spurred in programmed instruction by B. F. Skinner in 1954. The essentials of his system were:

1) Present information and/or questions to the learner;
2) Provide opportunity to the learner to respond; and,
3) Provide feedback.

Skinner applied the theory of behavioral psychology to the learning process. The "law of effect" is the basic building block for CAI. Essentially the assumption is: Behavior which is followed by pleasure is more likely to be repeated than behavior which is not followed by pleasure. This has also been called stimulus-response or S-R theory. It has been proven conclusively on animals. However, serious doubts still exist as to whether the "law of effect" is valid when applied to human learning. In spite of this Skinner became famous for his application of the principle to programmed instruction.

From these beginnings came the present day systems which use computer memory and storage capabilities. The student is given a question on the cathode ray tube (CRT)--the

stimulus. The answer is input through the keyboard and is the response. If the student gives the right answer, he receives pleasure in the form of positive feedback on the CRT.

C. COMPONENTS OF CAI

The three components of computer assisted instruction are: hardware, software, and user [Ref. 18: p. 9]. Interaction among these three components is very important. In the user's mind the computer should be a complement to his own intelligence. Computers have the power of data manipulation but they exhibit no creativity. A designer of CAI should realize this and avoid the pitfall of concentrating too much on the hardware and software at the expense of the user interface. The cost reductions in memory and speed of hardware indicate that the user interface has become the main yardstick by which CAI is measured.

1. Hardware

Recent advances in microcomputer technology have made computer assisted instruction more affordable. Two reasons are most likely for this result. Hardware prices have fallen consistently since the dawn of the computer age. Microcomputers are more common and easier to obtain than access to mainframe computing power. This makes training more accessible on microcomputers. In turn, this accessibility allows the cost of software to be spread over a

greater number of trainees [Ref. 19: p. 251]. Software costs are the largest expense for these systems.

The "microcomputer revolution" has also brought about another savings of sorts. Simplicity of operation has been emphasized because the microcomputer market is more attuned to the general public than to computer professionals. The mainframe computer establishment has long held the reputation of being "user hostile." The microcomputer industry directed its production to create "user friendly" systems targeted for the general public. Efforts in this direction have advanced to a stage approaching the ultimate "user seductive" system.

Technological advances in peripherals for computers have had a significant impact on the CAI application. The most recent has been the use of a videodisc as a secondary storage device. Chapter Two discussed the details of videodisc technology and its application to learning systems. Nearly instantaneous random access has a strong impact on the design of a computer assisted instruction lesson. For example, at any point in the lesson the user could be re-routed back to any other point in the lesson. This is called branching and will be addressed in more detail later in this chapter.

2. Software

a. General Purpose Languages

General purpose computer languages can be used to write CAI lessons. There are some advantages to using this approach. Innovation is much easier and program efficiency is better. Efficiency refers to both memory utilization and execution speed. The disadvantage is that proficiency in a language requires both a considerable amount of work and a great deal of experience.

b. Authoring Languages

Specialized authoring languages are available. These languages are easier to master than a general purpose language and they are tailored to the specific purpose of CAI lesson design. Because qf this specialty type design, the authoring language enables the programmer to use his time more efficiently. The programmer loses some flexibility compared to general purpose programming, but authoring languages are more flexible than the alternative that follows.

c. Authoring Systems

CAI authoring systems are the next step in the automation of CAI authoring. These systems can be used by a beginning computer user. This opens up the CAI authoring process to many more people than the first two alternatives. Authoring systems are "menu-driven." This means that the computer program leads the operator through the steps of

writing the lesson. The author is given various options from which to choose such as:

1) Enter text display for the student to view;
2) Enter a question for the student to answer;
3) Enter acceptable answers to the question;
4) Enter hints to student, repetitions allowed, or time limit for answering; and,
5) Enter the lesson point to which to branch based on the student's answer.

The authoring system automatically generates its own code for the computer execution of the lesson. A disadvantage is that these systems lock the author into one model of CAI thus limiting flexibility. This is outweighed by the advantage that the author does not need to be an experienced programmer to produce programs relatively quickly on the automated system.

d. CBESS

CBESS is an authoring system developed for the U. S. Navy. CBESS is an acronym for Computer-Based Educational Software System. The system was developed at the University of Utah from its VCIS (Video-computer Courseware Implementation System) software. Basically it is a set of tools that allow the author to create software comprised of text, graphics, animations, and video with flexible branching structures. An overview of VCIS is provided in Appendix A.

3. User

The user in CAI is the student. The interface between the student and the lesson is created by the author. That interface design is most important in determining the success of the system. A portion of the interface is determined by the psychological approach of the instruction system (most use the stimulus-response theory mentioned previously). The other part of interface is the dialogue between computer and student. This is the area over which the author has the most control. He determines how much text to present, how often to ask questions, and what to do based on the response to questions.

a. Learning Stages

One approach to dealing with the user/student is the concept of learning stages. "Stepwise learnability" breaks up the amount of information the user must assimilate into a series of unintimidating steps [Ref. 4: p. 100]. For the CAI designer, this may be interpreted as "Don't give too much information too fast." Each lesson should contain a manageable amount of information. Optimal length has not yet been established, but educational institutions seem to settle on the 45 to 55 minute time frame for convenience. Students are generally accustomed to that period of class length, therefore exceeding it may be unwise.

Each lesson should build on its predecessors. When this is done, the student progresses to the desired

educational objective smoothly with as little trauma as possible.

The CAI system can be designed in stages for different entry levels based on experience with the subject matter. This could be quite expensive if a set of lessons had to be designed for each level of entry expertise. A simpler approach is to design the lesson flow of one system to accommodate entry by more experienced students at later points in the program.

D. CAI DEVELOPMENT

It is estimated that it takes as many as 200 hours to produce, field-test, and validate a one-hour lesson [Ref. 17: p. 110]. Tools are being developed that can help to reduce this time. Authoring languages and systems have already been addressed. It is also apparent that a systems approach to CAI design would be appropriate. In general, the systems approach is as follows:

1) Analyze problem;
2) Specify required outcome;
3) Design system;
4) Create system; and,
5) Test and revise system.

For specific computer assisted instruction applications the systems model has five major parts.

1. Front-end Analysis

The first step toward the problem solution is the initial analysis. This should reveal target population, microcomputer to be used, subject matter, approximate length, and the time and other resources available.

2. Outcome Representation

The desired outcome of the lesson can be represented by a set of objectives. These objectives are usually included in the lesson to show the student what is to be accomplished. Objectives can be transformed into questions for the student to test his progress. In CAI these questions are called criterion frames and can be used to document the intended content of the lesson.

3. Lesson Design

Design has three different aspects.

a. Functional Design

This aspect considers the lesson's primary function. Is the CAI program the prime deliverer of information or does it reinforce learning from other sources? The latter points to the use of "drill and practice" as mentioned earlier in this chapter. Tutorial format lends itself to the former with the idea of presenting new material for learning.

b. Physical Design

The physical design of the CAI curriculum is analogous to the path the student follows through the

lesson. Two basic designs are linear and branching. Linear is most common and the simplest of the physical designs. Every student follows the same path through the lesson.

Branching involves a more complicated design, but it may have the highest return of the two methods mentioned here. There are alternate tracks through the lesson, usually selected and referenced based on the answers to the criterion frames. This format takes advantage of the computer's capabilities. With the advent of videodiscs this may become a more popular method for writing computer assisted instruction packages. Flow charts are an integral part of this design aspect. They document the desired physical flow of the lesson and ease the authoring process.

c. Logical Designs

These have their basis in behavioral learning theory. In a didactic design the student is given information and expected to regurgitate it in the form of answers to questions. A discovery design relies on the student to use his own judgment to reach conclusions about the subject. In this design the student is only provided only enough information to arrive at the correct conclusion.

4. Lesson Creation

It is often desirable to start designing the lesson by writing the criterion frames first. Most, if not all, of these can be lifted from the Outcome Representation of the systems approach. After the questions are written, the

teaching frames can be produced. These contain the text that answers the questions. Directions to help the student operate the software system are also required. The final step of this process is to enter the code or to manipulate the menu-driven system to enter the lesson.

There are three stategies which may be used in lesson creation to ensure the effectiveness and validity of the lesson.

a. Extensive Validation

The first is the most time and money consuming. It involves many validation cycles. The first iteration is usually not a complete lesson, but only criterion frames. The author would have to build on that base after each field test. Products of this strategy are well-researched and have a high degree of reliability.

b. Lean Lesson

An alternative is to write a complete lesson including both criterion and educational frames. It is understood that additions may have to be made since the first iteration is very "lean". Some validation is done and changes will be made before the system becomes fully operational. This strategy is a compromise between the preceding and succeeding methods and is the most common choice in light of financial and time constraints.

c. High Risk

In the third strategy the first iteration of the lesson is the final one. No time is available for validation. Because of the lack of validation the lesson must stand on its own merit. Obviously, there are some problems with this approach. It relies entirely on the quality of the first iteration and more likely than not contains a high degree of risk.

5. Lesson Validation

This may include a pre-test, post-test, and/or field testing. Validation is the feedback of the system and contributes to its revision. The more validation that a development effort uses, the higher the reliability when the lesson is finally offered to the student in its final environment. As pointed out previously there are tradeoffs inherent in the degree of validation. Time and money available frequently dictate this choice.

E. PRE-DEVELOPMENT CHOICES

Prior to beginning the development of the CAI lessons the development team must choose among the various approaches and methods that have been examined in this chapter. After those choices have been made, a checklist of pertinent points can be constructed for the development process to be followed. With this in hand, the team can

proceed toward tackling the problem to be solved with an appropriate, effective plan.

IV. AN EXPERIMENT IN VIDEODISC CAI

In December of 1983 an interactive videodisc training system was obtained and temporarily installed in the Naval Postgraduate School's Mathematics Department Microcomputer Laboratory. The primary objective of studying this system was to determine if the principles of both CAI and interactive videodisc design could be applied in the development of an interactive videodisc training program for the U. S. Navy. A second objective was to examine user response to such a system in order to determine if an interactive videodisc training program would be useful.

The system utilized a commercial videodisc player, a video monitor, a control box, and its controlling software to provide an interactive learning experience. It was connected to an IBM personal computer. The objective of the computer assisted instruction was to give the student the knowledge to operate the IBM PC, and to use the WordStar word processing and the VisiCalc spreadsheet software. VisiCalc was not available, so that part of the lesson was not addressed by this experiment.

This commercial system utilized two video monitors. The computer monitor displayed the normal text and graphics of the program (operating system or WordStar). The other monitor showed either actors in motion sequences of instruction

or pictures of actual operations on the computer monitor and keyboard. This system was designed to intercept all strokes to the keyboard and provide realistic simulation of operations on the computer without accidentally changing or circumventing the system software.

The system was left unattended with a set of written instructions posted for any interested individuals. Questionnaires were left to be completed by anyone who attempted the tutorial. Only eight persons eventually completed questionnaires. The raw results are shown in Appendix B. Although eight returns do not qualify as a statistically significant sample, the totals provide interesting data about the system.

A. QUESTIONNAIRE RESULTS ANALYSIS

1. Estimate of Microcomputer Experience

None of the eight persons claimed to be an expert in microcomputers. Most were students at the Postgraduate School with some computer experience. Seven of the eight judged that they had moderate or less experience with the WordStar program.

2. Student View of Level of the System

All eight of the respondents saw this system as directed at a beginner's level. This is also the targeted student group according to vendor information. In that regard the author seems to have met the objective of playing

to a specific audience. In doing this he may have lost some opportunities to reach more knowledgeable users. It was interesting that five of the eight said that the program was below their own experience level. Experience with computers tends to generate a degree of confidence in the user. An experienced user may be confident enough to experiment with a system. He may challenge the validity and effectiveness of the system and even discover some bugs in the system. This seemed to be the case with NPS students. The students who tried the system are probably more confident in their dealings with computers than the apparent student level for which this system is designed. A user who fears computers is more careful to strike only those keys he is told to strike.

The users were asked to pick perceived target groups for this tutorial. They were free to pick as many of the five choices as they wished. The group most frequently picked was junior GS (1-4) or junior enlisted (E1-E4) (five times). Next most popular with four selections was the next higher level group, mid-level GS (5-11) or mid and senior level enlisted (E5-E9).

3. Reactions to Hardware Features

Half of the respondents thought that the two screen presentation was helpful and another three said it was a no-effect situation. While not an overwhelming endorsement of

a two-screen system, this suggests that a two-monitor system has possibilities.

Even with two screens to watch, seven of the respondents admitted to being impatient several times, while waiting for the system to catch up to them. This is a dangerous sign. The moment a person is conscious that he is waiting for the machine, he begins to lose concentration on the task at hand. Some researchers have advanced the theory that the point of impatience becomes a problem when the subject is waiting for response more than two seconds [Ref. 21: p. 269].

The control box was equipped with a voice simulator which was used occasionally for warning messages or praise. Reaction to that voice was mixed. Only one person actually enjoyed it while most were indifferent. It was the opinion of some that the voice was condescending. This part of the user interface revolves around the user's fear of "who's really in charge here?"

4. Program Effectiveness

Six of those questioned estimated little or no improvement in their computer knowledge as a result of the instruction. This may also relate to the already high level of technical expertise that these students possess. It has been stated that most thought the program was below their microcomputer expertise. Based on that, it would not be expected that they could improve from exposure to something

they perceived as a low level, beginner program. A similar reply was obtained by asking if they felt any more comfortable with computers. Five said that they did not feel any more comfortable than before using the program.

5. Program Completion

Five students did not complete the tutorial. Most gave similar reasons for non-completion, usually because of lockup of the software resulting from a mis-key by the student. This kind of error was supposed to have been avoided by the use of the keystroke interceptor control box. Obviously, there were still some problems in that mechanism. The system did not account for all possible mistakes.

Half of the students spent less than an hour on the tutorial, while the other half spent between one and two hours. Two hours should have been more than enough time to cover the material. Interest could not be expected to exceed that time limit.

B. OVERALL EVALUATION

There were several complaints about the system.

1. Foreknowledge Assumption

The system assumed that each student had some initiation before starting the lesson. The system authors assumed that each student would read the accompanying twenty-page manual before sitting down at the machine. This is a task that is not done in many computer education

situations. A better approach might be to make interactive videodisc CAI systems stand alone without aid from a volume of written instructions. This method is usually more palatable to the student. The author should assume that each student has to be shown the on/off switch by some outside source. Everything else should be taught by the program.

The respondents complained that instructions for powering up various components of the system were hard to follow. Sometimes simply turning on these computer systems can be a frustrating experience. This is an argument for placing such systems in a manned space. The personnel in the space would have as a secondary duty the requirement to instruct students on power-up procedures. This is not an unrealistic requirement for the Navy situation. Many likely locations for such a system are in spaces that are normally staffed during working hours and sometimes around-the-clock. This presence may also have its disadvantage as covered in the next paragraph.

2. Embarrassment of Failure

With this experimental system there were instances when students were embarrassed because they could not get it to work properly. Such embarrassment causes frustration with the system, and even if the student overcomes the hurdle, it prejudices him against it. Embarrassment may be magnified if the place of instruction is public or even semi-public. The problem is compounded if the student works

at a different level in the organization than others present during system operation. In the military, for instance there is a general reluctance to admit ignorance to those personnel either above or below your own rank.

3. Bugs in the System

The main reason that only three of eight students completed the tutorial was system bugs. In the words of the students "the system froze," "WordStar bombed out," "software crashed," and "made a mistake and couldn't get out." All these seem to relate to the process of intercepting keystrokes with the control box prior to execution. The idea seemed on the surface to be a good one, but was not executed properly. A 37.5% completion rate is not acceptable.

4. Student Comments

Generally the evaluation by the students was negative. The approach seemed to be correct, but the execution requires additional testing. The computer literacy factor mentioned previously may explain why the NPS students found the system inadequate. Some specific comments were: "Looked flashy, but very frustrating to use", "Felt program was too rough to be used by anyone yet", "Why do we need a monitor to take a picture of a computer video monitor?", "The tutorial that comes with the IBM PC is much better ...", and "The videodisc linkup has its advantages but is not better than other tutorials I have used."

On the positive side one student commented. "I like! Would like to run through this a number of times. Once through isn't enough to learn."

C. EVALUATION SUMMARY

It appeared that the authoring team skimped on the design process and tried to compensate with attractive packaging and salesmanship. The bugs probably could have been eliminated by using a thorough design and validation process. The vendor probably did not utilize a systems approach to the effort. Several of the steps described in Chapter Three of this thesis would have enhanced the system. A great deal more validation must be done before this IBM PC tutorial is a good one.

It can be concluded that viable interactive videodisc training programs can be developed by using the principles of both CAI and interactive videodisc design. The design of these programs should be done carefully and with great concern for the target audience. Chapter Five of this thesis discusses a methodology for designing videodisc courseware.

V. DESIGNING AND AUTHORING VIDEODISC COURSEWARE

Interactive videodisc courseware begins as an idea. This idea is transformed through numerous stages in the design process to produce an interactive training package. The design process has no shortcuts, and it cannot be side-stepped without risk of an inferior product.

A. A NEW MODEL FOR COURSEWARE

As technology progresses and new teaching aids are perfected, educators must rethink entire educational programs and strategies in order to take advantage of the new equipment.

> Not unlike the development of personal transportation technology just before the turn of the century, when the then mature delivery system (animal muscle power) had reached its maximum output, and a brand new technology (the internal combustion engine) was fueling the forces for a major change in the way people traveled, we are presently seeing our mature post-World War II instructional methodologies giving way to substantial pressure of entirely new systems of instructional technology which we scarcely understand. [Ref. 22: p. 29]

The task of the educator is to learn and understand the new technology. Understanding the new technology involves the recognition of its range of possibilities. The videodisc should be used creatively, not as merely a new means to display the same old videotapes and lessons. Michael L. DeBlocis points out [Ref. 22: p. 30] that neither the microprocessor nor the videodisc will be used to their

potential as long as educators use design models based on vintage hardware.

A design model may be a framework, flowchart, or plan for structuring an interactive videodisc lesson. To be effective, it must include what DeBloois calls the _structural elements_ and the _process elements_, which comprise the whole interactive videodisc system [Ref. 22: p. 31]. It is apparent that no design model suited to older forms of instructional materials could possibly be adequate for the new systems.

In order to devise a new model for a particular combination of hardware and software, the designer must have a working knowledge of the capabilities and limitations of that combination. Several configurations are possible.

> _First_, the remote controller . . . can be used to manually load program steps into the internal memory of the videodisc player. . . . _Second_, [some] players can receive a program from a computer floppy disc or cassette. . . . _Third_, if a digital program exists on the videodisc, then the program can be inserted into the player's memory without using a computer. . . . _Fourth_, with a computer properly interfaced to the videodisc player, programs stored on floppy disc can provide motion sequences or still frames from the videodisc and at the same time present text or graphics either on the computer terminal or on the T.V. monitor. . . . _Fifth_, these same programs could be stored on the videodisc during the mastering process and can then be unloaded from the videodisc into the external microcomputer memory. [Ref. 23: pp. 76-77]

The configurations which contain or automatically load a program avoid manual user error. The fourth configuration is frequently more useful than the fifth because the computer program can be altered or updated with relative ease.

In the fifth configuration, the overall cost is lower because no accompanying floppy disc is necessary. However, the computer program is permanent and, at present, unable to be erased or changed on the videodisc. Both of these configurations provide maximum utilization of computer memory and branching logic for a powerfully interactive system.

Interactive videodisc educational systems have many advantages over videotape and computer instruction systems but there are disadvantages as well. Figure 1 [Ref 22: p. 34] lists both advantages and disadvantages which should be considered before embarking on an interactive videodisc project. The list further emphasizes that this is a unique medium encompassing a variety of visual, audio, and program possibilities. For the first time, all of these possibilities are realized in one system.

When the educator or system designer understands the interactive videodisc system, he must then consider the components of an individual lesson or tutorial. An interactive videodisc lesson may include a pretest or statement of objectives, simulations, information presentation, questions or interactive tasks, practice sequences, tests, and interactive sections which utilize the capacity of the computer or the video sections to provide a "physical feel" for the subject not possible through any other system [Ref. 24: p. 94]. In addition, the educator must decide the type of control to be utilized. CAI generally places the control

CHARACTERISTICS OF INTERACTIVE VIDEODISC EDUCATIONAL SYSTEMS

Advantages

1. Individualized
2. Self-paced
3. Learner data collection and storage
4. Branching capabilities
5. Computation options
6. Variable learner input systems (touch screens, light pens, voice activated, voice recognition
7. Easy revision of computer text, graphics, and program logic
8. Color text options
9. Audio capability
10. Two separate audio tracks
11. Very large data storage capacity
12. Still images
13. Motion images
14. Slow motion
15. Fast motion
16. Full color capability
17. Three-dimensional
18. No degradation of audio and video
19. Low-cost courseware in moderate volume
20. Very low maintenance history
21. Portable
22. Rapid random access of all learning cues
23. Spatial index of components

Disadvantages

1. Added hardware cost
2. Limited revision capability of audio and disc video
3. Additional development time required
4. Not transparent

Figure 1

with either the student (self-paced instruction) or the system (predetermined sequences) [Ref. 23: p. 77].

In interactive videodisc lessons, both types of control may be used separately or in combination. The system control approach can be designed to display sequences only when the learner has proven ready through interactive evaluative sections. The order of sequences is predetermined but the pacing is indirectly controlled by the student. The learner control approach may permit the student to select the order of the sections, difficulty level, test options, and study methods, but the sections themselves may be system controlled for order of presentation, pace of testing, and other factors. [Ref. 23: p. 77]

B. PRINCIPLES OF DESIGN

The educator who has studied the interactive videodisc system and determined his basic strategies for the lesson is ready to formulate his design model. This is not entirely an uncharted area, for Michael DeBloois has proposed thirteen principles, quoted and described below, as a guide for the designer. [Ref. 22: pp. 32-65]

1. Principle One

> An interactive videodisc system is not merely a merging of video and computer mediums; it is an entirely new medium with characteristics quite unlike each of the composites.

The educator who has truly studied the system, as described in the previous section, has already recognized this fact.

2. Principle Two

> To develop interactive videodisc systems, adequate resources are required. Designers must also be entrepreneurs and solicitors; expanded potential for learning is accompanied by an expanded need for resources.

DeBloois' primary concern here is that an underfunded videodisc project will never be completely successful. Figure 2 [Ref. 25] shows the prices for mastering and replicating charged by four major videodisc companies. The service is not inexpensive, but this step is only the last one in a long line of even more expensive steps.

MASTERING AND REPLICATION AT PIONEER, SONY, 3M,
AND TECHNIDISC

Financial Breakdown	Pioneer	Sony	Technidisc	3M
Interactive CAV				
Set-up		$4,000	$4,000	$5,000
10 copies	$5,350	4,320	4,230	5,230
100 copies	7,000	7,200	6,250	7,300
1000 copies	26,000	30,000	25,000	26,000
Linear CAV				
Set-up		$2,000	$1,500	$1,800
10 copies	$2,130	2,190	1,680	1,980
100 copies	2,800	3,900	3,100	3,200
1000 copies	10,000	17,000	12,500	11,800
Other services				
Check disc	$500	NOT AVAILABLE	$550	$550
Check tape			250	250

Figure 2

Interactive videodisc courseware costs begin with the initial outlay for design and concept. The execution of the design will undoubtedly require consultants from

specialized fields to cover the subject. A production staff could include writers, actors, video technicians, a director, and computer programmers. Also, the first version requires evaluation, adjustment, and re-evaluation. The final version is then taped, mastered, and produced. The costs incurred by these steps are substantial. Figure 3 [Ref. 22: p. 39] shows a rough budget estimate for developing and mastering a one-sided interactive videodisc. The budget is based on the actual expenditures for a number of interactive videodisc projects [Ref. 22: pp. 39-40].

PROSPECTIVE BUDGET FOR ONE-SIDED INTERACTIVE VIDEODISC

	low end	average
Front-end analysis and design	$ 7,000	$ 15,000
Treatment and scripting	4,000	8,000
Subject matter consultants	3,000	6,000
**Pre-taping production	1,500	5,000
**Taping and pre-mastering	20,000	30,000
**Mastering	2,500	5,000
Project management	10,000	12,000
Computer programming	8,000	15,000
Evaluation	1,500	4,500
	$57,500	$100,500

** Depending on features built into the interactive system and on availablity of visual source material.

Figure 3

The principle of high cost should not be considered a problem or stumbling block. The educator must be aware of the expenses in advance in order to insure that sufficient funds are available to see the project through its

conclusion. Further, the issue of cost could provide the impetus for universities and institutions to pool their resources and creative teams to the benefit of all. Even small colleges could participate in a program distributed in this manner by contributing teachers or technicians instead of funds [Ref. 24: p. 91]. The team of designers and authors is the crucial factor in the process and the cost of hiring a sufficiently varied and expert group of individuals could be excessive. A cooperative program would greatly reduce this cost for all concerned.

Another consideration for a budget-conscious designer is that the courseware be suitable for a wide variety of users and be as applicable a few years hence as it is at present. This implies that the program components be stored on a floppy disc rather than on the videodisc to allow for ease of modification. Additionally, courseware should be based on data files rather than programs in order to adapt easily to different operating systems, languages, or processors. [Ref. 24: pp. 91-92]

3. Principle Three

> The objectives which are written for interactive videodisc systems must reflect the instructional needs identified for a wide variety of potential learners.

This principle affects the cost considerations discussed above. It also stresses the need for sufficient branching to accommodate both the novice and the expert in order to provide truly individualized instruction. The needs of

potential users must be assessed before the system is designed.

4. Principle Four

> The design effort must be interdisciplinary in nature, capable of a full range of activity, crossing professional specialties, and involving personnel from disparate fields.

This was discussed earlier from two perspectives. First, the medium demands expertise in a variety of fields so that a team of designers is practically unavoidable. Second, the cost of a team is substantially reduced when institutions combine efforts and such combinations produce a broad-based creative team.

5. Principles Five, Six, and Seven

> The way the treatment of the subject matter is handled within the learning design is very important. Treatment decisions must allow for frequent, meaningful, and "upbeat" attractive opportunities for learner interaction.
>
> Feedback to learners should take both serious and humorous forms and be a constant design feature.
>
> Learner motivation is the sine qua non of interactive video design.

Few people in this age can claim complete ignorance of videogames and mass media. The pull of videogames on the interest level of most people is undeniable. A lesson that could approximate this popular style to any degree would have an edge in engaging the user's interest. Humorous reinforcement tested by the U.S. 7th Army (USAREUR) in Germany in an interactive videodisc lesson met with favorable response [Ref. 22: pp. 51-52].

6. Principles Eight, Nine, Ten, and Eleven

> Instructional cues presented learners must be of the highest quality.
>
> Training equipment and supporting software must be dependable.
>
> Project planning and management is critical; project control can be gained through the use of appropriate planning techniques and devices.
>
> The expense of interactive videodisc systems warrants accountability. Evaluation is essential for assessing quality, effectiveness, efficiency, and worth.

These quality control principles are aimed at assuring the finest possible courseware for the investment of time and money. Quality of the visual elements must have a high priority because of the pervasive influence of television. Users will tend to expect the same polished look of the best television show. Additionally, the user will expect the equipment to function properly. A malfunction could be frustrating and counter-productive.

Principles Ten and Eleven focus on the responsibilities of the production team. The production staff must provide economical production, plan and meet hundreds of deadlines, and prove the reliability and quality of the system, both hardware and courseware. More importantly, production and creative teams are often called on to validate the worth of the expensive videodisc system compared to a more conventional or older training system. Is the high cost more than warranted by increased efficiency and better student response?

7. Principles Twelve and Thirteen

> The use of a hardware system must be as transparent as possible.
>
> Formal and informal information dissemination channels must be developed.

One key to good interactive videodisc courseware is the ease with which a learner can use a system. "Transparency" refers to this facet. A non-transparent system would be one in which the user had to know complex access procedures, or one which was designed in a confusing manner. Everything must be clear and easy to use for the learner to avoid computer anxiety. The use of advanced peripherals (discussed in Chapter Two of this thesis) could be extremely helpful in some applications.

An interactive videodisc courseware designer must keep abreast of technology in order to utilize new developments and peripherals when possible. Principle Thirteen suggests that direct contact with others in the field is the fastest way to obtain new information. A network of researchers and designers cooperating for the purpose of information exchange could provide vital assistance to all interactive videodisc users and creators.

8. Summation

The principles devised by DeBloois provide insight into the complex process of interactive videodisc design. However, actual authoring of courseware directly from these principles would be difficult. Basic authoring forms

provide a physical model or framework in which specific elements may be inserted for a particular system.

C. BASIC AUTHORING FORMS

For a computer programmer, an interactive videodisc computer program is a major undertaking. For an educator or designer with little computer programming experience, the task would be nearly impossible without authoring systems and implementation systems.

There are three basic authoring forms available to the designer. These may be used to map the design prior to production. The three forms are storyboards, grid frames, and branching networks or flowcharts. These three forms spring from the need to specify motion sequences, still frames, and the manner of interaction or branching to be implemented. [Ref. 23: p. 78]

A storyboard form consists of two parts. A box on the left side is used to sketch rough line drawings of the motion sequence. On the right side, the actual audio message and/or a description of background sounds is written. Additionally, it is possible to include instructions to the camera-person or the director.

The grid frame is used for message layout of still frames that are to appear. A grid frame can be easily constructed on graph paper by placing a border around an area of 30 to 35 squares horizontally by 12 to 15 squares

vertically. The author then uses the enclosed area to design the message by placing characters in adjacent squares. Still frames designed with this method should not resemble pages of text, but should be similar to good overhead transparencies with lots of space between lines.

Branching networks or flowcharts are used to describe the branching options allowed in an interactive videodisc program. A compact numbering scheme is needed to label the still frames on the storyboard and to develop these branching networks or flowcharts. Any alphanumeric system that is internally consistent can be used. "Branching networks provide a 'road map' of all the lesson components showing their relationship to each other." [Ref. 23: p. 82]

A script for interactive videodisc courseware should contain the three forms discussed: storyboards, grid frames, and branching networks. All three can be combined onto a single card. This may be more useful for designing interactive videodiscs where motion sequences are short and where many opportunities for branching are needed.

Once the various forms have been used, there is a demonstrated need for sophisticated software to aid in the transistion from plan to computer program [Ref. 26: p. 158]. There are several types of software to support training systems. First, authoring systems that fully incorporate video provide adequate support for the non-programming author. Second, authoring utilities provide for greater

ease of programming using higher level languages. Third, machine code driver routines facilitate the interface between high-level languages and video devices. Last, productivity tools facilitate menu construction, branch and logic testing, and preparation of digital dumps for both stand-alone disc systems and computer/disc and tape systems.

In order to convert the design into an interactive computer program, the designer may use an implementation program. The University of Utah has developed such an implementation system. It is appropriately called Video-computer Courseware Implementation System (VCIS). The U.S. Navy has been licensed to use this system to produce courseware for its new command and control (C^2) workstation. An overview of VCIS is contained in Appendix A.

D. EVALUATING COURSEWARE EFFECTIVENESS

The final step in the creation of interactive videodisc courseware is evaluation of effectiveness. The primary objective of using videodiscs in education is to create more effective courseware. Four factors contribute to this objective. First, it is important to carefully design the courseware so that the student will learn the material. After using the courseware, can the student do the problems or can the trainee perform the task? The latter implies that job performance measures must be identified.

Second, a student's time is valuable. Effective courseware permits the more capable student or trainee to progress rapidly but also provides the necessary help to those who need it.

Third, presentation of material should be modified with changes in student or trainee population. Major changes to the courseware may have to be made on the basis of significant differences in the capabilities of the target group. If the material is designed with care, the changes can often be minimal.

Fourth, courseware validation and modification should be included in the development process. All student answers should be recorded so lesson evaluation programs can be used to analyze the student answer data. In this way, designers can identify areas in the courseware that are ineffective or unnecessarily time-consuming. Courseware should be validated before it is given to students or trainees. Refinement and evaluation should also continue after students or trainees have begun using the material. Modifications should be possible using the information from the lesson evaluation programs.

A practical and comprehensive evaluation checklist has been devised by Robert Wooley [Ref. 26: pp. 163-168]. It examines specific issues under general areas in an attempt to evaluate the effectiveness and quality of individual

aspects of a system as well as the system as a whole. The checklist is reproduced in Appendix C.

E. CONCLUSION

The intricate design and authoring process seems less complicated when approached with suitable tools. DeBloois' Principles of Design and the basic authoring forms serve to demystify the process and divide it into workable and manageable areas of concentration. The use of these principles and forms in the development of an interactive videodisc training program for the Sun Workstation will be demonstrated in Chapter Six of this thesis.

VI. PROJECT DESIGN

The topic selected for this interactive videodisc tutorial design is the screen-oriented text editor, "vi." This program is available on the Sun Workstation, the hardware selected as the test bed for the U. S. Navy's new Command and Control (C^2) Workstation research. The text editor is probably the most frequently used program on any computer, be it a microcomputer, minicomputer, or main frame. Therefore, users must be taught how to use the available text editor. It is especially appropriate for this research because:

1) It is representative of the type of material of interest;
2) The amount of material is manageable so a system could be designed; and,
3) Every quarter, twenty or more new students at the Naval Postgraduate school must learn "vi." They constitute an excellent test and evaluation group representative of the target population discussed below.

"Vi" is a screen-oriented text editor. There is a "vi" tutorial available on the Naval Postgraduate School's Computer Science Department VAX 11/780 minicomputer. It is an interactive, sequential program. Use of the tutorial is

accomplished by entering the text editor and moving through the various sections, under control of the editor. The user learns by doing. The tutorial presents information to the user in the form of full screens of text resembling pages of a book. This visual presentation is very difficult to read because too much information is presented at once. The tutorial is dry and dull, and it takes several hours to complete.

A creative interactive videodisc tutorial, such as the one proposed in this chapter, will serve to improve the existing tutorial and aid user interface with the machine. This first iteration is intended to describe the backbone of the tutorial from which development can proceed in an orderly fashion. Given this intent, validation, criterion frames, and a high degree of interactivity are desirable but not critical to this design. The methodology used in the design of this interactive videodisc tutorial involves four of the five steps of CAI development as stated in Chapter Three of this thesis.

A. DESIGN STRATEGY

1. Front-end Analysis

The target population is U. S. Naval officers at Lieutenant or Lieutenant Commander level, or higher. The system on which the tutorial is to be implemented is the Sun Workstation. Figure 4 shows the configuration for hardware

PHYSICAL LAYOUT OF SUN WORKSTATION FOR CAI

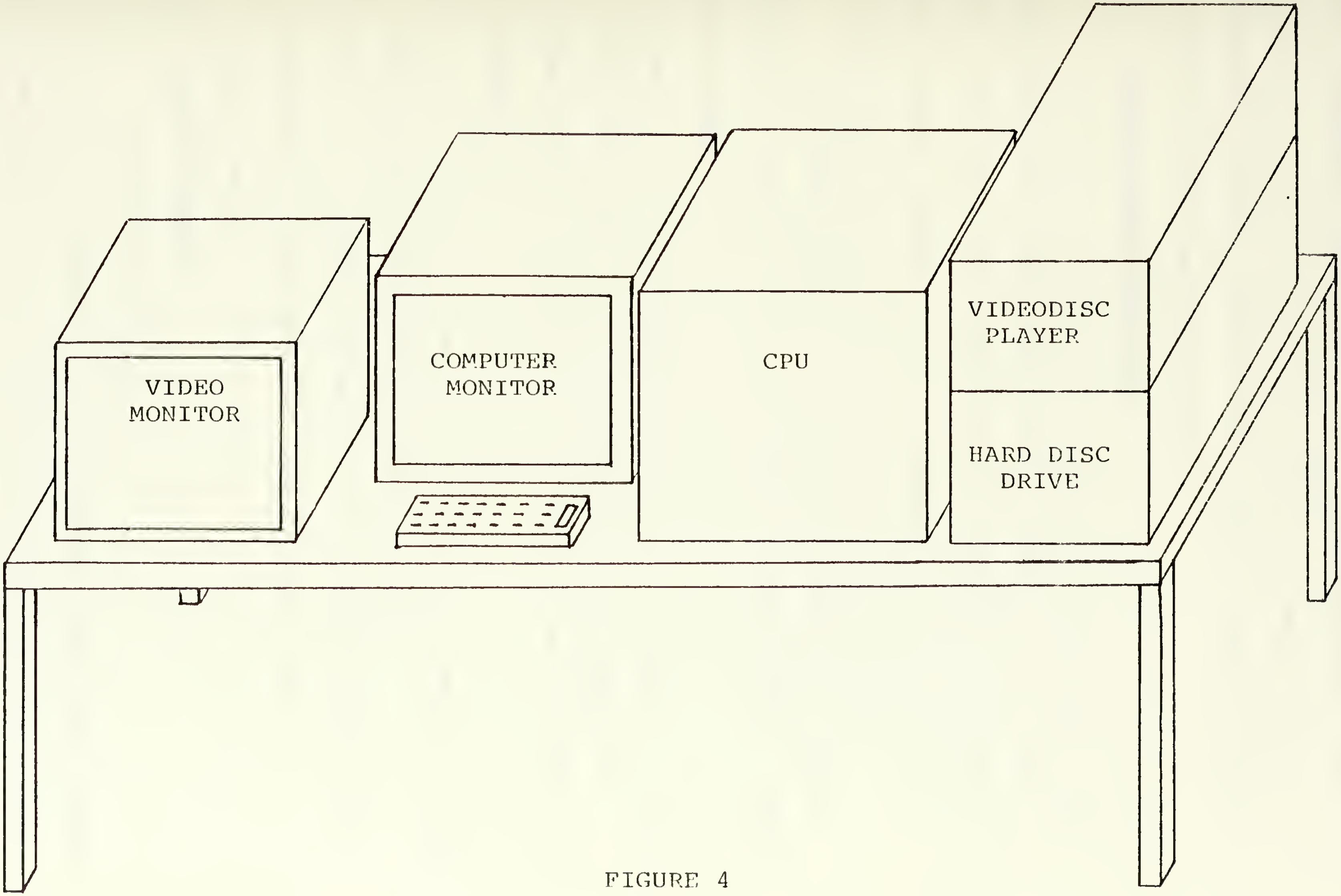


FIGURE 4

set-up necessary to execute the proposed design. The subject matter is "vi." The main sections, Basic Topics, Intermediate Topics, and Advanced Topics, should take no more than one hour each to complete.

2. Outcome Representation

The objectives of this design are two-fold. The first is to teach the student how to use the "vi" text editor. This will be accomplished by teaching him each command and its result. The presentation will strive to put the student at ease during the learning process.

The second set of objectives is aimed at future interactive videodisc training program development. These objectives are:

1) Demonstrate the capability of microcomputers in conjunction with the interactivity of a videodisc;
2) Demonstrate the utility of the multi-media aspect of a videodisc;
3) Create a base from which a production team can further develop and validate the tutorial; and,
4) Stimulate further research toward systems with more interactivity and greater use of artificial intelligence.

3. Lesson Design

a. Functional Design

This program is the prime deliverer of information. Therefore, it is a tutorial rather than drill and

practice. It will be a menu-driven, highly structured design. This will most likely limit the degree of interactivity and therefore restrict the extent to which the system can customize itself to the individual user.

b. Physical Design

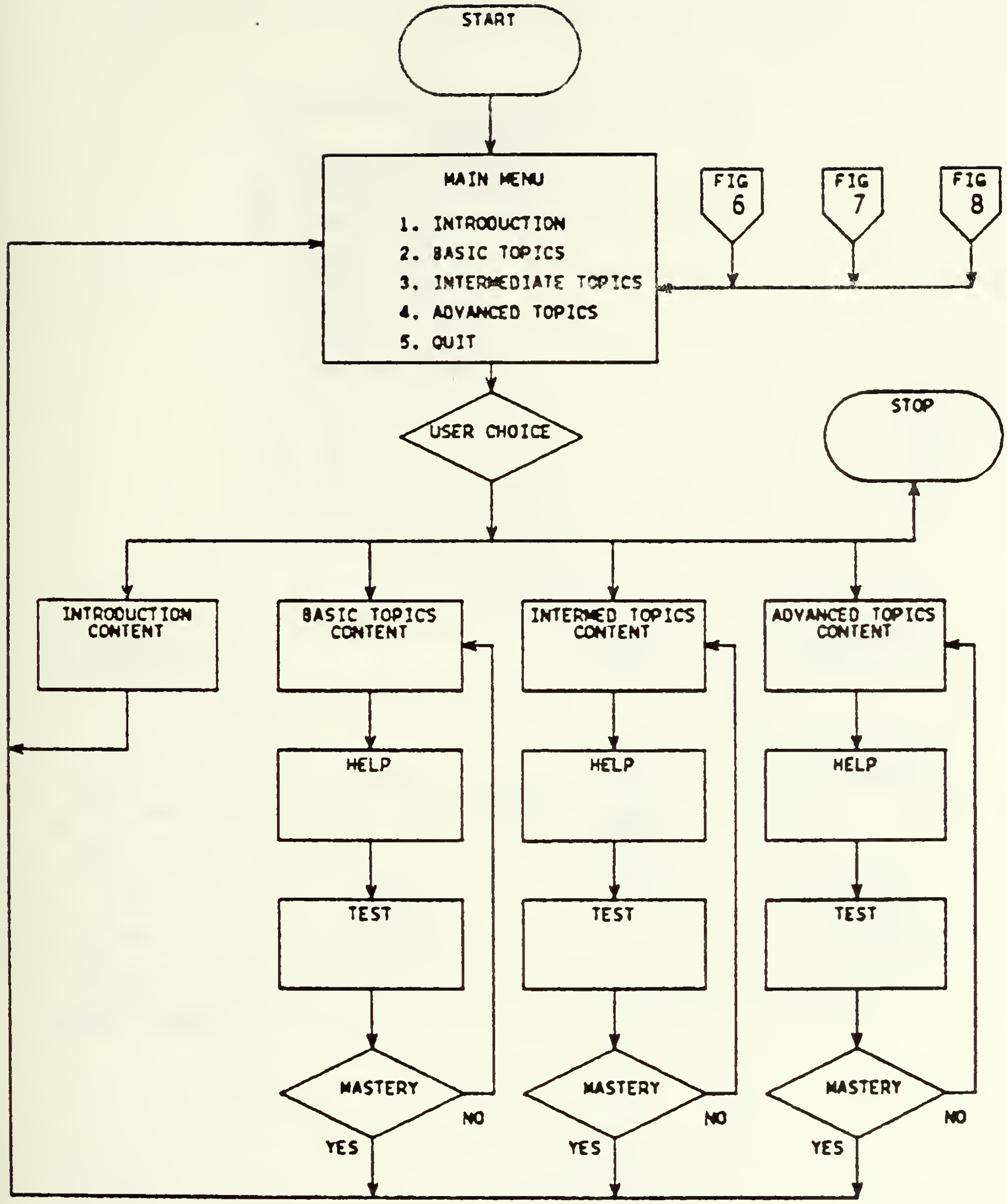
The design will utilize branching. Figure 5 shows the high-level branching network, or flowchart, for the "vi" tutorial. Figures 6, 7, and 8 represent abstractions of lower level detail for the Basic, Intermediate, and Advanced Topics segments, respectively.

c. Logical Design

The design is a didactic one for several reasons. The volume of information required to operate the text editor efficiently is such that a "hit or miss" learning approach would be very frustrating. Also, the time involved in such an approach is a luxury that the U. S. Navy cannot afford. Finally, this type of material does not lend itself to experimentation and inductive or deductive reasoning, unless the user is intimately familiar with the text editor.

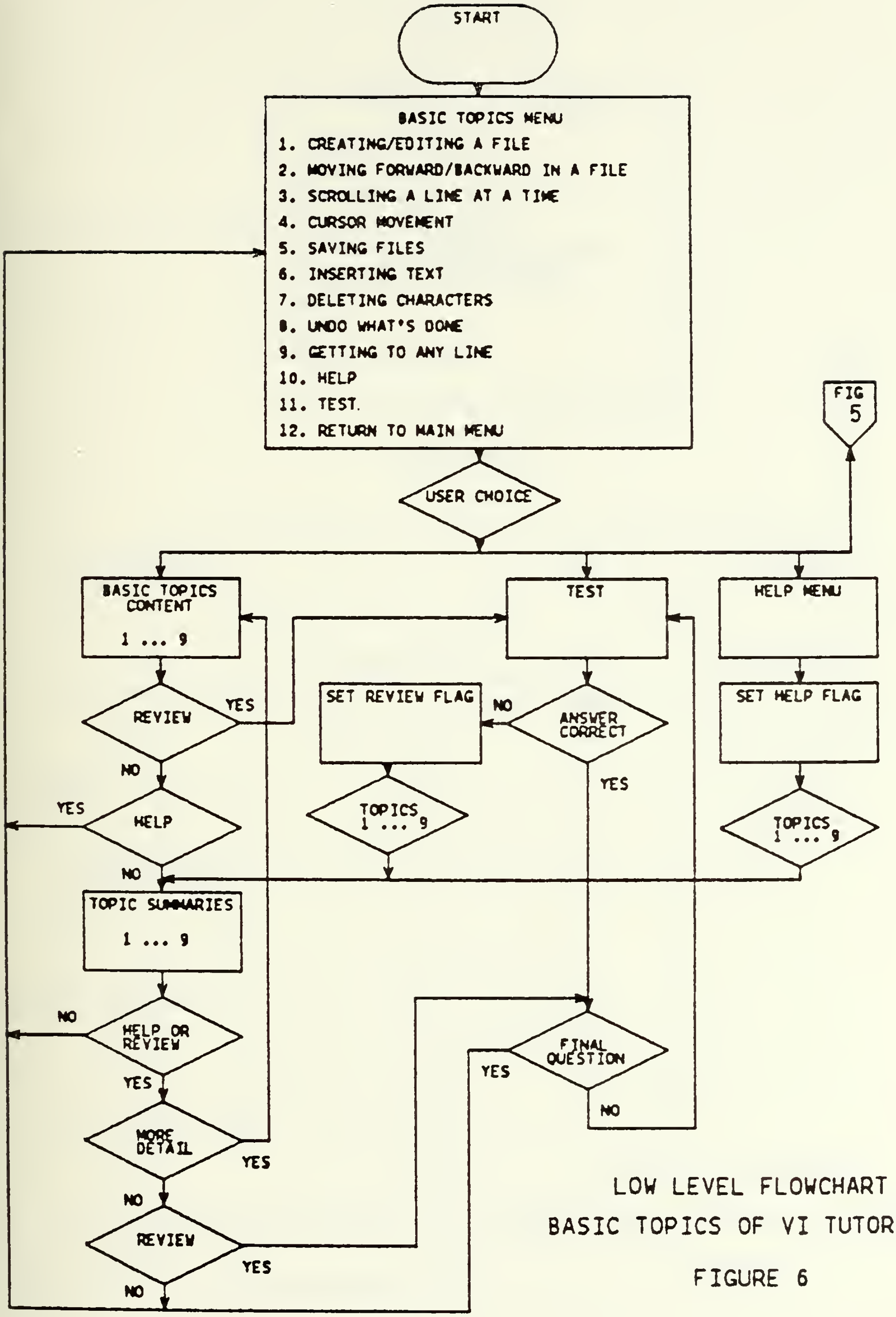
4. Lesson Creation

A "lean lesson" approach is used for this design. No validation will be done on the material and no criterion frames will be included. Provisions will be made for a test in each major section, but questions will not be developed.



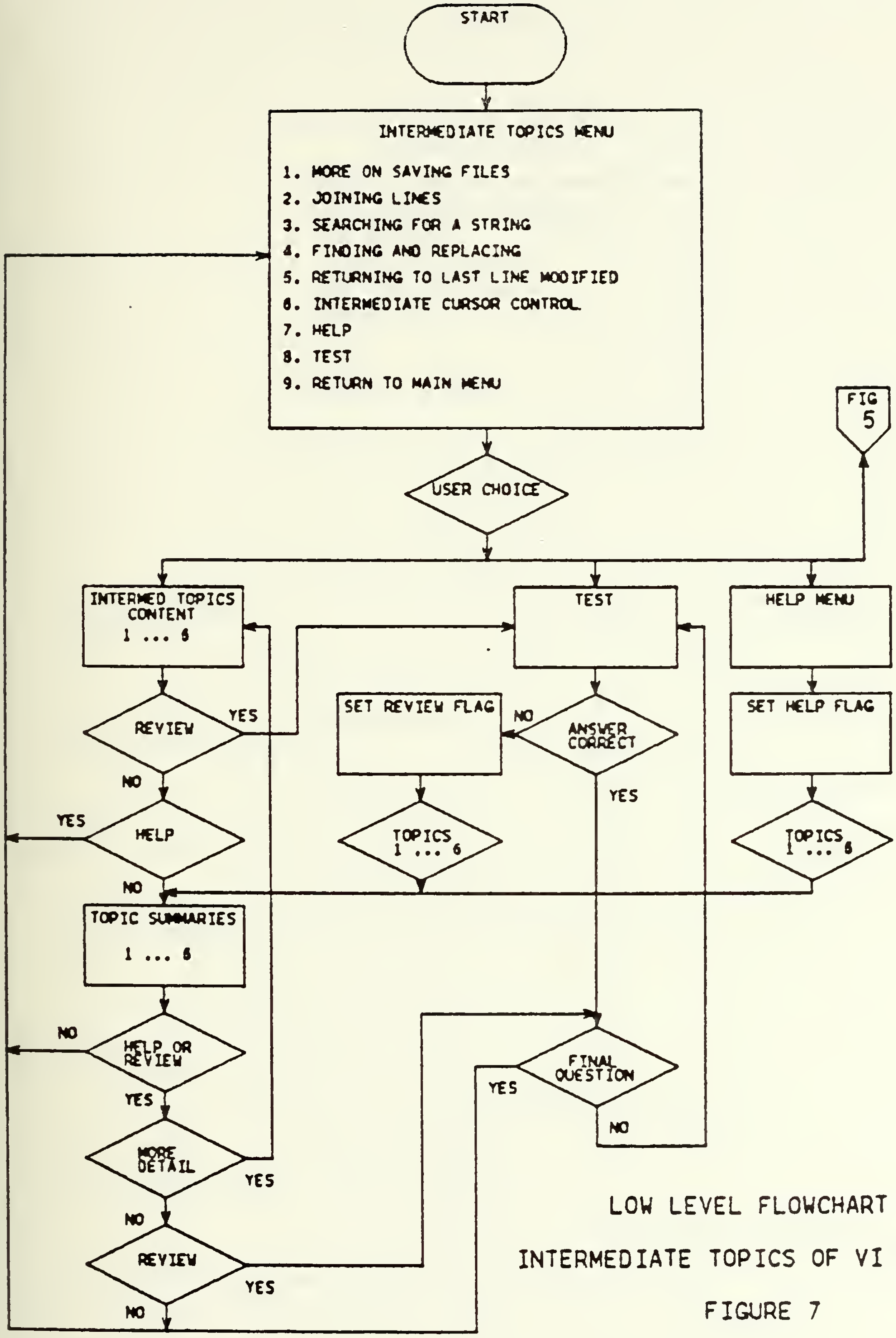
HIGH LEVEL FLOWCHART FOR VI TUTORIAL

FIGURE 5



LOW LEVEL FLOWCHART
BASIC TOPICS OF VI TUTORIAL

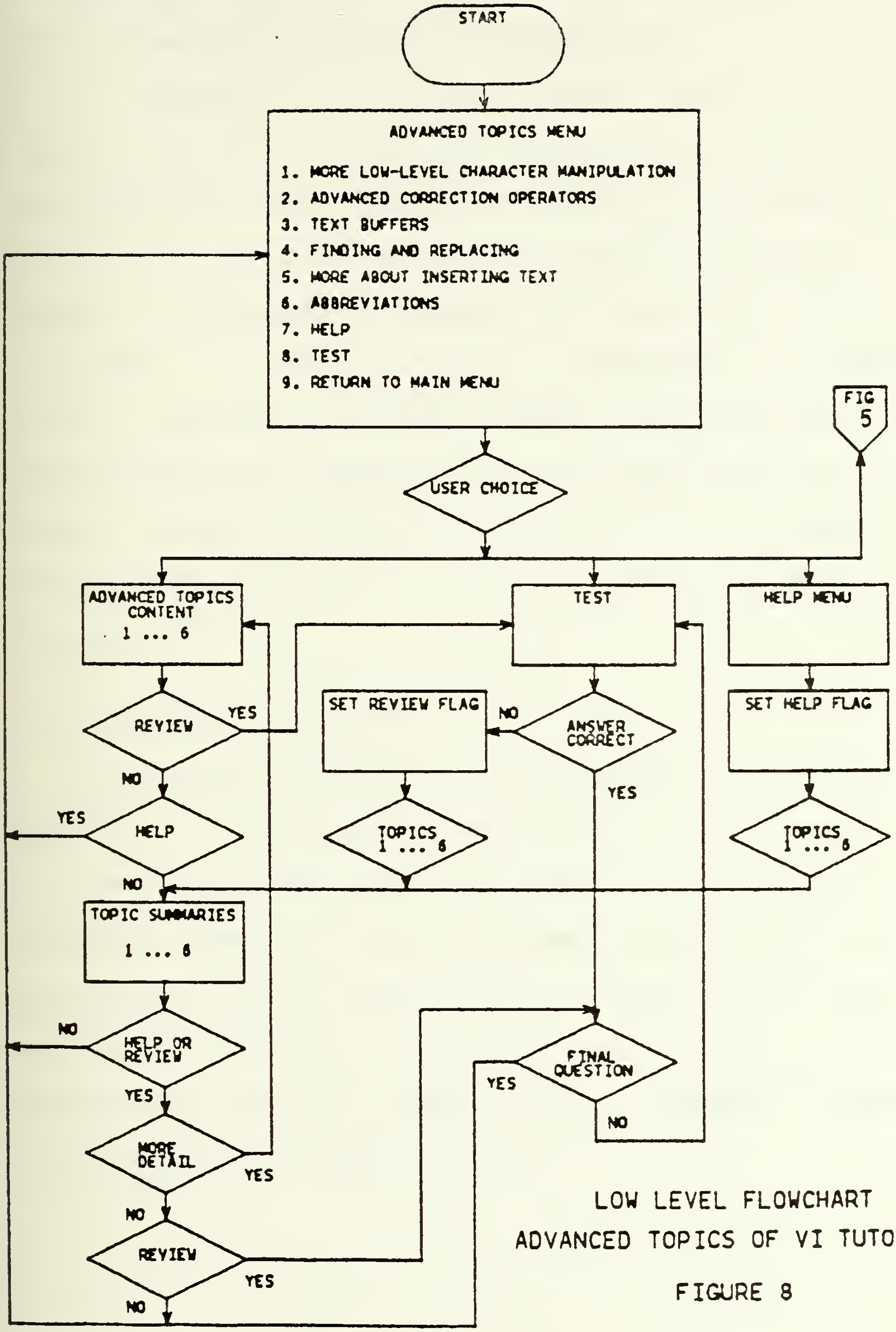
FIGURE 6



LOW LEVEL FLOWCHART

INTERMEDIATE TOPICS OF VI TUTORIAL

FIGURE 7



LOW LEVEL FLOWCHART

ADVANCED TOPICS OF VI TUTORIAL

FIGURE 8

As stated earlier in this chapter, validation and changes will be necessary prior to implementation.

Directions to help the student operate the tutorial will be included. A help menu will be available in each of the three sections. Each will contain the same topic listing as its parent menu. Entering the help function will result in the student's seeing the summary for the particular topic. If more information is desired, the student can enter the appropriate lesson segment from the topic summary. Additionally, the student will have three choices at the end of each segment. He can continue to the next segment, escape to the menu, or review the information just presented.

B. DESIGN DOCUMENTATION

The design documentation is supplied in Appendix D of this study. It presents a storyboard and rough script for the tutorial. Alphanumeric messages to be displayed on the computer screen are included; however, these have not been formatted on grid frames because of space limitations. Each segment is presented in a linear manner in the storyboard. Branching is shown by comments such as "BRANCH TO SELECTION" or "BRANCH BACK TO BASIC TOPICS."

VII. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

This study achieved its primary goal of producing a preliminary interactive videodisc design for the Sun Workstation. The information gathered and presented in Chapters One through Five of this thesis was used to develop the design. The multi-media capabilities of the interactive videodisc and microcomputer system were used to create a broad design encompassing all major facets of the "vi" text editor. Extensive validation is necessary to verify the design's effectiveness. The checklist in Appendix C could also be used to evaluate the design.

The intent of this design was to lay the groundwork for a system to be expanded and validated by future research. This approach appeared to have the greatest potential value to future researchers. An alternate apporach could have selected one or two "vi" commands and completely developed, validated, and produced an interactive videodisc tutorial for them. This vertical approach would have proved that such a program will work for training users of the Sun Workstation. It would not have attacked the more difficult task of designing a broad system applicable to all major facets of "vi." The design proposed in this study is a

starting point for research and development rather than a prototype to be rigidly copied.

The design as it now stands is less interactive than the tutorial it is intended to replace. Although it is a menu-driven, highly structured design, the user learns by listening and observing rather than by doing. The manner in which this design presents material to the student is, however, an improvement. This design succeeds in presenting information in a clear, concise, and visually interesting format. Further development can increase user interactivity.

The process of researching the technology and creating the design yielded many valuable observations. Designing an interactive videodisc tutorial is a time-consuming process. More than 75 hours were required just to produce the design in Appendix D, which at best is only a partial design without tests and criterion frames. Still more time will be required to include these and to improve interaction. An extensive re-design effort will be necessary to elevate this design to the status of an expert system which utilizes artificial intelligence.

The private sector already employs interactive videodisc training systems in a variety of fields discussed in Chapter Two of this thesis. Video sequences, still photos, computer-generated alphanumerics, and audio combine to create auto-instructional training programs which tailor the instruction to the needs of the individual. This study

further demonstrates that this multi-media approach is a valuable one which could be used to great advantage by the U. S. Navy. The topic selected for the design in Appendix D is typical of material which must be taught to new users of Navy computer systems. Information is transmitted to the user through all available media. This provides reinforcement of key concepts in a manner which attracts and retains the user's attention. As noted in Chapter Two of this thesis, learning is best achieved when the learner is interested and engaged in the process.

The format used to document the design was particularly effective for the alphanumerics. The boxes encouraged economical use of computer-generated alphanumerics because they approximate the grid frames specified in Chapter Five of this study.

B. RECOMMENDATIONS

It is recommended that a subsequent project aim toward implementation of the design in Appendix D. This will require validation and development of tests and criterion frames. Such a project should also strive for a "learn by doing" method with more interactivity, perhaps through simulation or drill and practice segments. Successful completion of test segments should be rewarded with video or alphanumeric congratulations, such as a message superimposed on a video sequence of fireworks.

The program for controlling the interactive videodisc system should be produced using one of the latest versions of an authoring system. The program should also provide for tracking a student's progress and collecting data on all users. One such choice for the Navy is CBESS, which is currently being installed at the Naval Postgraduate School. The initial implementation should be validated by using a videotape to store the video sequences. The Navy should use professional writers, actors, directors, and video technicians as part of the design team to ensure a high-quality audio-visual presentation. Following validation of the tutorial and development of criterion frames, a professional production group such as the Educational Technology Division, Fort Gordon, Georgia, should be put under contract to produce the necessary videodisc master.

Further development should strive to use artificial intelligence to improve the system. Researchers should also examine cognitive science research and study models of human thought and problem-solving. The application of these to the system would necessitate the inclusion of different learning formats. This would allow each user to adopt the most appropriate and effective learning format for him.

Emphasis on auto-instructional methods will reduce the amount of time required of experienced personnel to train new users. The most important aspects of interactive videodisc courseware development are project planning and

management control. Coordination of the steps in the process is critical to success. The Navy must pay close attention to these aspects for future research and development in the area of interactive videodisc training programs.

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APPENDIX A

OVERVIEW OF VCIS

The following overview of VCIS is excerpted from the VCIS User's Manual, University of Utah Video-computer Courseware Implementation System Version 2.0c, by Richard C. Brandt and Barbara H. Knapp, University of Utah Research Foundation, 1983, Chapter 2, pp. 1-9.

> This chapter introduces the University of Utah Video-computer Courseware Implementation System (VCIS). It is a package of programs for use on a microcomputer that facilitates the implementation and modification of computer-assisted lessons incorporating video material; no programming is required. It contains interactive programs for: (1) the editing of text, graphics, and animations; (2) selecting video materials; (3) sequencing the material created with the editors and specifying the branching decisions; and (4) analyzing the data collected during the lessons.
>
> 2.1 COST-EFFECTIVE IMPLEMENTATION
>
> In designing the implementation system major emphasis was placed on reducing the cost of implementing and modifying courseware on microcomputers by simplifying courseware implementation and in most cases eliminating the need for a programming staff. The implementation system is easy to use without significantly restricting educational strategies. In fact, by including capabilities such as animations and sophisticated answer parsing that you might not attempt if programming were required, your capabilities are extended. In addition, the implementation system was designed to encourage the development and use of effective computer-based learning materials. The implementation system provides detailed information on student performance so you can determine the effectiveness of new ideas. The time to implement a lesson is sufficiently short that new ideas can be experimented with.
>
> Computer-based learning materials will be cost-effective ONLY if they are widely used. This follows from the

high cost of developing the courseware. Even with the implementation system, the cost of courseware development remains high. . . . Several factors have inhibited the widespread use of computer-based learning materials. First, very few effective computer-based lessons have been written. Second, it has been difficult to modify existing material to meet local needs. Instructors are more likely to use materials if they can easily modify them to meet the needs of their own students. Third, most of the good material that is now available for use on microcomputers does not include record keeping so either the students must keep their own records or proctors must be used. Fourth, without the detailed record keeping available with a computer, it is difficult for an instructor to identify ineffective parts of a lesson.

VCIS addresses these issues. It is easy to modify existing courseware to meet local needs. There is detailed record keeping for courseware evaluation. The cost for the hardware and software needed to start creating courseware at an accredited nonprofit educational institution is less than $10,000. As of May 1, 1981 twenty-seven educational institutions ranging in size from Ricks College in Idaho to Cornell University in New York have licensed VCIS. A wide variety of courseware is being created. Examples are remedial math at Mission College in California, navigation at the U.S. Naval Academy, biology at Florida Institute of Technology, pathology at Indiana Medical School, and legal accounting at Harvard Law School.

. . . .

2.3 COURSEWARE DESIGN

VCIS enables you to employ educational strategies appropriate to a particular learning situation. The system permits you to design courseware that emulates the tutor-pupil mode, stresses mastery learning, includes interactive dialogues and tasks, and provides tests with immediate feedback to the student.

. . . .

2.4 FRAME COMPOSITION AND EDITING

The basic element of the lesson is called a frame. The implementation system has editors for creating and modifying frames and a video selection program for choosing video portions. Conceptually, an empty frame resembles a clear transparency, not a blank sheet of

paper. A frame may contain text or graphics. Frames are created EXACTLY as the student will see them in the lesson; furthermore, changes made to frames are immediately visible to you. The editors are easy to use because the options are always displayed and the dialogues between the different editors and the user are similar and concise.

The text editor, TEXTEDIT. . ., permits you, with a minimum number of keystrokes, to position text on the screen and adjust or remove individual lines or blocks of text. The empty text frame contains 23 lines of 80 characters. . . or, optionally, 23 lines of 40 characters.

Using any of the 192 characters available from the keyboard, text can be placed anywhere on the frame. Specialized character sets such as those with mathematical symbols or cursive characters may be used at any time simply by changing the name of the character set. Since each frame is like a transparency, a question can be displayed on one frame and the appropriate response to the student's answer can be displayed by superimposing another frame. If the response is placed on the frame so that it does not cover the initial question, the initial question will still be displayed to the student. This saves repeating the question on the response frame and storing redundant text. Both blank spaces and characters are opaque and cover text on the screen when superimposed on any text.

Graphics frames may be displayed while the text frames are being created. This ensures that text labels and explanations will agree with the graphics when presented to the student. Other features of the text editor allow you to overlay text frames to view their appearance, move rectangular portions of text without altering the remainder of the frame and recover text removed inadvertently.

The graphics editor, GRAFEDIT. . ., is used to place graphic objects on the screen. The empty graphics frame contains 240 rows of 320 dots. . . .

The dots in the graphics frame can be either on or off. Like the text frame, an empty graphics frame resembles a clear transparency and graphics can be superimposed on text frames or other graphics frames. Text frames may be displayed while the graphics frames are being created.

Four primitive objects are available in the graphics editor: The line, circle, arc, and curve. Graphics frames are created by positioning these objects on the screen using the keyboard cursor control keys or a

graphics tablet to specify reference points. . . . These primitive objects can be used to create a wide variety of figures. If a graphic will be used in more than one position on the screen, it is created as a user-defined object. User-defined objects, created from the primitive objects and other user-defined objects, can be positioned anywhere on the screen by specifying one reference point. Libraries of user-defined objects can be created.

An animation is a sequence of drawings displayed rapidly to create the illusion of motion. The animation editor, ANIMATE. . ., is used to create and edit up to 20 drawings and specify the display sequence. The empty animation drawing contains 64 rows of 64 dots, a section of the graphics frame. . . .

The video selection utility program, SELECT. . ., allows you to preview and select video segments. The program displays the video frame numbers on the computer monitor and permits you to save the desired start and stop frame numbers in a file for later use in the lesson building program.

If a lesson requires a feature that is not supported by the implementation system, a procedure written in Pascal can be added to the program which presents the learning material. The Pascal procedure is called a special. . . .

2.5 COURSEWARE ASSEMBLY

The courseware assembly program, BUILDER. . ., is used to establish the order of presentation of the text, graphics, animations and video selections included in the learning material and to create the branch points. . . .

With the BUILDER, you: (1) specify the order for displaying the frames created with the editors; (2) indicate which frames contain questions, entering the anticipated answers for each question and providing an appropriate response for each anticipated answer as well as a response for any unanticipated answer; (3) specify what to do if a student does not answer within a defined time period; (4) indicate where the lesson should pause for either a specified video frame number, or a student's signal to proceed, or a specified time period; and (5) specify when all or a portion of the screen should be cleared.

With BUILDER you create a lesson segment which consists of four data files: an instruction file, a command file, a text frame file and a graphics frame file. . . .

The first step in implementing courseware is to refine the flowchart or outline specified during the design phase. A practical approach is to divide the lesson into segments and build and test each segment before assembling the entire lesson. Segments are merged either by the linker program, LINKER. . ., which combines the separate text, graphics and instruction files or by BUILDER which uses the separate command, graphics and text files to create the lesson.

. . . .

At decision points the type of data that will be provided for comparison with the anticipated answers must be specified. This data can be entered by the student from the keyboard, calculated by the computer for a random problem, stored in computer memory, or based on student performance. If data is being entered by the student, it can be a character, screen position or in a general form. The general form of answers includes: key words, logical combinations of key words, patterns embedded within words, real numbers or algebraic equations.

. . . .

Another feature of VCIS which may be included in a question structure is the timed response. For example, if a student does not answer within a specified time period, some help could be offered. If the student still does not respond within the time period, the solution and then more practice could be given.

The number of anticipated answers specified will vary for each question. Both design and implementation time will be saved if only the most probable answers are specified as the anticipated answers. The lesson evaluation program, LESEVAL. . ., can be used to identify the remaining answers which students frequently give. Appropriate responses can then be added to the lesson for these answers.

2.6 STUDENT USE OF COURSEWARE

The lesson is run by an interpreter system, INTERP. . ., which uses the student's answers and the instruction file to direct the presentation of material. INTERP compares the student's answers to your designated anticipated

answers. A student's path through the material is described by recording for each question: time to answer; question path number; and whether the answer is right, wrong or neutral. If the answer is unanticipated, the actual answer is stored. A separate disk is used for each lesson. . . .

An instructor specifies presentation options that control: whether student data will be collected; if students will be able to back up, comment, or quit at any time; whether spelling errors will be allowed; if video material will be included; the contents of the reply list. The lesson manager program, MANAGER. . ., is used to specify these options.

. . . .

Refinement of courseware is an important aspect of computer-based instruction. A major emphasis of VCIS is to facilitate lesson refinement and thereby promote the production of quality lessons. Three stages in the courseware development process may be used for review and refinement. The initial evaluation occurs prior to implementation. . . .

After the material is implemented it is reviewed for errors in structure and presentation and modified as necessary. The final stage of refinement occurs after the material is tested by students. . . .

The implementation system simplifies lesson refinement by providing a lesson evaluation program, LESEVAL. . ., which processes student data. This program provides histograms of the number of students that answered each question correctly and incorrectly and the average time taken in answering each question. In addition, for each question the lesson evaluation program provides a table showing the number of students taking each path, a summary of all the various unanticipated answers, and the frequency of each of these answers. This data is used to evaluate the effectiveness of the lesson and to locate the problem areas.

VCIS lessons are modular: text, graphics and lesson structure are in separate files. Consequently any changes to the text or graphics frames are done with the implementation system editors and reassembling the lesson is not necessary. The lesson structure is recorded in the command file and may be modified in BUILDER or modified with the System Editor. . . . When a command file is modified

it must be used as the source of commands for BUILDER to create the lesson which includes the changes.

APPENDIX B

QUESTIONNAIRE RESULTS

1. Estimate your previous microcomputer experience.

beginner		intermediate		expert
2	1	2	3	0

2. Estimate your previous experience with WordStar.

none		moderate		extensive
3	0	4	0	1

3. What level of computer knowledge do you think this training program was directed to?

beginner		intermediate		expert
8	0	0	0	0

4. How does this compare to your own level?

below		even		above
5	1	1	1	0

5. What did you think of the two screen presentation?

distracting		no effect		helpful
0	1	3	0	4

6. How many times did you feel impatient waiting for the machine to catch up to you?

none		several		many
1	0	3	1	3

7. What did you think of the voice from the control box?

disliked		indifferent		enjoyed
1	3	3	0	1

8. Did you absorb any new knowledge?

none		moderate		lots
1	5	1	1	0

9. Do you feel any more comfortable with microcomputers?

beginner		intermediate		expert
5	1	1	1	0

10. Did you finish the tutorial?

yes	no
3	5

11. How much time did you spend on the tutorial?

< 1 hour	1-2 hours	2-3 hours	>3 hours
4	4	0	0

12. At what level would this tutorial best be directed assuming no knowledge of computers? (CHECK AS MANY AS YOU WISH)

junior GS (1-4) or junior enlisted (E1-E4)	5
mid-level GS (5-11) or mid and senior enl (E5-E9)	4
junior officer (01-02)	2
senior GS (12-14) or mid-level officer (03-04)	0
senior GS (15 & up) or senior officer (05 & up)	0

APPENDIX C

MEDIA TECHNICAL EVALUATION CHECKLIST FOR INTERACTIVE VIDEODISC SYSTEMS

SA=Strongly Agree A=Agree
D=Disagree SD=Strongly Disagree
NA=Not Applicable

DESIGN CONSIDERATIONS	SA	A	D	SD	NA
1. The lesson used video capabilities effectively.	4	3	2	1	0
2. Branching decisions were made at appropriate instructional points.	4	3	2	1	0
3. Reinforcements were timely and aided learning.	4	3	2	1	0
4. Objectives and purposes for the training were clearly stated.	4	3	2	1	0
5. Objectives appeared to be based on real needs of the trainees.	4	3	2	1	0
6. The overall design was flexible enough that materials could be used in both individual and group training sessions.	4	3	2	1	0
7. An overall design strategy is evident. Content moves from lower-level objectives to higher-level skills.	4	3	2	1	0
8. Avenues for review and remediation are provided and placed under learner control.	4	3	2	1	0
9. Various entry levels of trainees are adequately assessed and handled.	4	3	2	1	0
10. Lesson examples are generalizable to on-the-job activities.	4	3	2	1	0

11. The program effectively challenges trainee creativity.	4	3	2	1	0
12. Use of the lessons is motivational.	4	3	2	1	0
13. Color is used appropriately for instructional reasons.	4	3	2	1	0
14. Sound is used appropriately for instructional reasons.	4	3	2	1	0
15. The learner has control over the rate and sequence of presentation and review.	4	3	2	1	0

CONTENT CONSIDERATIONS

1. Content is well-suited to an interactive style of instruction.	4	3	2	1	0
2. Content is accurate.	4	3	2	1	0
3. Content is current and timely.	4	3	2	1	0
4. Content is clearly presented.	4	3	2	1	0
5. Content maintains trainee interest effectively.	4	3	2	1	0
6. The rate of presentation was appropriate for the difficulty of the material.	4	3	2	1	0
7. The style of presentation was appropriate for the intended audience(s).	4	3	2	1	0
8. Sex and ethnic stereotypes were not used.	4	3	2	1	0
9. Transitions between content areas were handled poorly.	4	3	2	1	0
10. Learning activities were easily understood.	4	3	2	1	0
11. Content presentation seemed to support the objectives and purposes of the training.	4	3	2	1	0

12. Learning activities did a poor job of supporting acquisition of content. 4 3 2 1 0

13. Content was not dependent upon color recognition. 4 3 2 1 0

14. Content was not dependent upon audio recognition. 4 3 2 1 0

15. Lesson sequencing was confusing. 4 3 2 1 0

16. Major lesson points lacked closure. 4 3 2 1 0

17. Explanations of concepts were confusing or unclear. 4 3 2 1 0

18. Summaries and conclusions were well-utilized. 4 3 2 1 0

TESTING

1. Testing items were a direct reflection of purposes and objectives. 4 3 2 1 0

2. Testing items were well-integrated with learning activities. 4 3 2 1 0

3. Test items are clear and without ambiguity. 4 3 2 1 0

4. Testing strategy does not measure actual training performance. 4 3 2 1 0

5. Test items force no real discrimination of concepts by the trainee. 4 3 2 1 0

6. Testing is monotonous and boring. 4 3 2 1 0

7. Test items are reinforced when appropriate. 4 3 2 1 0

8. Scoring and recordkeeping are provided. 4 3 2 1 0

9. Diagnostic testing is used to assess entry levels. 4 3 2 1 0

10. Test items are at proper difficulty levels. 4 3 2 1 0

11. Testing was generally not relevant to learning. 4 3 2 1 0

VIDEO QUALITY

1. Color quality was excellent. 4 3 2 1 0

2. Illustrations were of high visual quality. 4 3 2 1 0

3. Graphics were effectively formatted for video. 4 3 2 1 0

4. Screen formatting was poorly handled. 4 3 2 1 0

5. Text was always clear and easy to read. 4 3 2 1 0

6. Text backgrounds were well-chosen and enhanced readability. 4 3 2 1 0

7. Special effects were effectively employed. 4 3 2 1 0

8. Transitions between video sequences were distracting. 4 3 2 1 0

9. Edits were not noticeable. 4 3 2 1 0

10. Motion sequences were of high technical quality. 4 3 2 1 0

11. Narrators gave no visually distracting cues. 4 3 2 1 0

12. Actors used in the training were effective. 4 3 2 1 0

AUDIO QUALITY

1. Sound was free of obvious distortion. 4 3 2 1 0

2. Narrator enunciation was clear and distinct. 4 3 2 1 0

3. Narration was free from distracting accents or mispronunciations.	4	3	2	1	0
4. Narration was well-paced.	4	3	2	1	0
5. Narration was easy to listen to.	4	3	2	1	0
6. Music was effectively utilized.	4	3	2	1	0
7. The second audio track was not well-utilized.	4	3	2	1	0

VIDEODISC/TAPE PROGRAMMING

1. The program failed almost randomly.	4	3	2	1	0
2. The program failed consistently and in the same locations.	4	3	2	1	0
3. Program dumps were distracting to the user.	4	3	2	1	0
4. The program worked with no observable error conditions.	4	3	2	1	0
5. Program branching was so complex that a user could "get lost" in the program.	4	3	2	1	0
6. The program makes effective use of the program features of the videodisc/tape player.	4	3	2	1	0

SYSTEM USE CONSIDERATIONS

1. The trainee can easily use the videodisc/tape equipment.	4	3	2	1	0
2. The instructor can easily use the videodisc/tape equipment.	4	3	2	1	0
3. The trainee can easily use the videodisc/tape.	4	3	2	1	0
4. The instructor can easily use the videodisc/tape.	4	3	2	1	0

APPENDIX D

VI VIDEODISC TUTORIAL DESIGN

This Appendix contains the proposed design for an interactive videodisc training program for the Sun Workstation. The subject matter is "vi," the available text editor. It is layed out as picture, alphanumerics, and audio, and should be examined from left to right, top to bottom.

PICTURE	ALPHANUMERICS
Workstation stillframe	Welcome to the Sun Workstation Press any key to begin
Workstation stillframe Narrator sitting in front of workstation	Introduction to the Sun Workstation Word Processor 1. Introduction to vi 2. Basic Topics 3. Intermediate Topics 4. Advanced Topics 5. Quit

*** BRANCH TO SELECTION ***

	Introduction to vi Press Return Key to Begin

AUDIO ONE

Narrator: Welcome to the Sun Workstation vi tutorial. This program will teach you how to use the word processor on the Sun Workstation. Use the up and down arrow keys on the right side of the keyboard to position the cursor next to your choice. Then press the return key.

*** BRANCH TO SELECTION ***

PICTURE	ALPHANUMERICS
Video sequence of narrator at workstation	

*** RETURN TO MAIN MENU ***

Still frame of several child's building blocks with characters A, B, and C facing viewer	BASIC TOPICS 1. Creating/Editing a File 2. Moving Forward/Backward in a File 3. Scrolling Line at a Time 4. Cursor Movement 5. Saving Files 6. Inserting Text 7. Deleting Characters 8. Undo What's Done 9. Getting to any Line 10. Help 11. Test 12. Return to Main Menu

*** BRANCH TO SELECTION ***

Still frame of several file folders neatly spread	Creating or Editing a File Press ESC to return to menu Press return key to continue

AUDIO ONE

Narrator: Learning a new computer system implies learning a new text editor or word processing system. This tutorial will familiarize you with the visual screen-oriented editor called vi. This text editor runs under the Unix operating system. An operating system is a program that makes the electronic hardware of a computer usable for a human being. It is an interface between the user and the hardware. Another term for the operating system is system software.

*** RETURN TO MAIN MENU ***

Narrator: Position the cursor next to the topic of your choice and press the return key.

*** BRANCH TO SELECTION ***

Narrator: In this section, you will learn how to create a new file or how to edit an existing file. Press the return key to continue.

PICTURE

Still frame of several
file folders neatly spread

ALPHANUMERICS

vi <filename> <RET>
or
vi <filename><filetype><RET>

Type B to review material
Press ESC to return to menu
Press return key to continue

Still frame of several
file folders neatly spread

SUMMARY

vi <filename> <RET>
or
vi <filename><filetype><RET>

Type B to review material
Press ESC to return to menu
Press return key to continue

*** BRANCH BACK TO BASIC TOPICS ***

Video sequence of up and
down arrows on either side
of message "BY SCREEN".
Place flashing question
marks at pointy ends of
arrows.

Moving Forward or Backward
in a File a Screen at a
Time

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: To enter the vi editor from the operating system, simply type vi, in lowercase letters, followed by the name of the file you are creating or editing. Then press the return key. A filename may contain up to eight numbers and letters and must start with a letter. A file name may also contain an optional filetype which also may contain up to eight numbers and letters.

Narrator: This section has taught you how to create a new file or edit an existing file using the vi screen editor. Future sections will teach you how to get around in a file and other text editing commands.

*** BRANCH BACK TO BASIC TOPICS ***

Narrator: This section will teach you how to get around in a file a screen at a time.

PICTURE

Still frame of keyboard with finger pointing to control key

ALPHANUMERIC

The CONTROL key is marked .

CTRL

^ = CONTROL KEY <CTRL>

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of user pressing appropriate keys followed by screen showing results.

^F = Forward by Screen

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of user pressing appropriate keys followed by screen showing results.

^B = Backward by Screen

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: Many of vi's commands require that you press the control key simultaneously with the letter representing a particular command. Familiarize yourself with its location now. The symbol for the control key is a caret.

Narrator: To move forward a screen, or 24 lines, you must press the upper case F and control keys simultaneously.

Narrator: To move backward a screen, or 24 lines, press the uppercase B and control keys simultaneously.

PICTURE

Video sequence with a ^B above the up arrow and a ^F below the down arrow. Message "BY SCREEN" is between the arrows and the ^B and ^F are flashing

ALPHANUMERICS

SUMMARY

^F = Forward by Screen

^B = Backward by Screen

Type B to review material
Press ESC to return to menu
Press return key to continue

*** BRANCH BACK TO BASIC TOPICS ***

Video sequence of up and down arrows with flashing question marks at the pointy ends. Between arrows is message "BY LINE".

Moving Forward or Backward
in a File a LINE at a Time

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of user pressing appropriate keys followed by screen showing results.

^Y = Forward by Line

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: You have now learned how to move forward or backward a fixed number of lines.

*** BRANCH BACK TO BASIC TOPICS ***

Narrator: This section will teach you how to move just one line on or off the screen.

Narrator: Typing an upper case Y simultaneously with the control key will scroll the whole screen down one line, keeping the cursor on the same line, if possible. However, if the cursor is on the last line of the screen, then it is moved to the previous line in the file.

PICTURE

Video sequence of user pressing appropriate keys followed by screen showing results.

ALPHANUMERICS

^E = Backward by Line

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of up and down arrows with message "BY LINE" in between. ^Y is above the up arrow, and ^E is below the down arrow. ^Y and ^E are flashing.

SUMMARY

^Y = Forward by Line

^E = Backward by Line

Type B to review material
Press ESC to return to menu
Press return key to continue

*** BRANCH BACK TO BASIC TOPICS ***

Video sequence of flashing cursor--enlarged.

Cursor Movement

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: Typing an upper case E simultaneously with the control key will scroll the whole screen up one line, keeping the cursor on the same line, if possible. However, if the cursor is on the first line of the screen, then it is moved to the next line in the file.

Narrator: Control Y and Control E give the capability to scroll the screen up or down a line at a time.

*** BRANCH BACK TO BASIC TOPICS ***

Narrator: This section will teach you everything you need to know about cursor movement. There are many details, so pay close attention, and remember to press the B key to review a segment.

PICTURE	ALPHANUMERICS
Video sequence of keyboard with user's fingers pointing to all four arrow keys	Type B to review material Press ESC to return to menu Press return key to continue
Video sequence of user pressing appropriate keys followed by screen showing results.	^D = Down Type B to review material Press ESC to return to menu Press return key to continue
Video sequence of user pressing appropriate keys followed by screen showing results.	^U = Up Type B to review material Press ESC to return to menu Press return key to continue

AUDIO ONE

Narrator: By far the easiest way to move the cursor is to use the arrow keys. The only exception is that they do not work when you are inserting text--we'll talk about that later. This method of moving the cursor does not change the display.

Narrator: In order to move the cursor down into the file, scrolling the screen, press the upper case D and control keys simultaneously.

Narrator: Typing an upper case U and the control keys simultaneously moves the cursor up into the file, also scrolling the screen.

PICTURE

Video sequence of user pressing appropriate keys followed by screen showing results.

ALPHANUMERICS

H = Top

M = Middle

L = Bottom

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of user pressing appropriate keys followed by screen showing results.

Cursor movement within a line.

0 (zero) = Beginning of line

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of user pressing appropriate keys followed by screen showing results.

j	h	k	l
down	left	up	right

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: These commands are very easy to remember. Upper case H puts the cursor at the top of the screen, upper case M puts the cursor in the middle, and upper case L puts it on the bottom.

Narrator: Up to this point, we have concentrated on positioning the cursor withing the file. Now we will take a look at positioning the cursor within a line. A zero will always move the cursor to the beginning of a line.

Narrator: There are several commands which will move the cursor around the screen at a time. Notice that these commands are all lower case letters. This text editor differentiates between what a command does by whether or not it is upper case. For example, an upper case H does something completely different from a lower case h. As you may recall, an upper case H moves the cursor to the top of the screen, and we have just told you that a lower case h move the cursor left a character at a time.

PICTURE	ALPHANUMERICS
Video sequence of user pressing appropriate keys followed by screen showing results.	w = Jump Forward to Beginning of Next Word Counting Punctuation as Words unto Themselves W = Jump Forward to Beginning of Next Word Ignoring Punctuation Type B to review material Press ESC to return to menu Press return key to continue
Video sequence of user pressing appropriate keys followed by screen showing results.	b = Jump Backward to Beginning of Previous Word Counting Punctuation as Words unto Themselves B = Jump Backward to Beginning of Previous Word Ignoring Punctuation Type B to review material Press ESC to return to menu Press return key to continue
Video sequence of user pressing appropriate keys followed by screen showing results.	e = Jump Forward to End of Next Word Counting Punctuation as Words unto Themselves E = Jump Forward to End of Next Word Ignoring Punctuation NO BACKWARD CAPABILITY Type B to review material Press ESC to return to menu Press return key to continue

AUDIO ONE

Narrator: This series of commands may seem a bit confusing. These commands let you move the cursor to the beginning or end of words. The key to understanding them is that the upper case commands use only spaces, tabs, or carriage returns to separate words. The lower case commands treat punctuation marks--such as periods, semi-colons, and commas--as words in and of themselves. Upper case and lower case W take you to the beginning of the next word. The upper case W ignores punctuation while the lower case w treats punctuation marks as words.

Narrator: Upper and lower case B move the cursor backward to the beginning of the word in the same manner that upper and lower case W moved the cursor forward to the beginning of the next word.

Narrator: If you are interested in the end of the word and not the beginning, then upper and lower case E will do the job. These commands only move forward and there are no corresponding reverse movement commands.

PICTURE

```
ALPHANUMERICS

      SUMMARY

^D = Cursor Down 1 Line
^U = Cursor Up 1 Line
 H = Cursor to Top of Screen
 M = Cursor to Middle of
       Screen
 L = Cursor to Bottom of
       Screen

Type B to review material
Press ESC to return to menu
Press return key to continue
```

```
      SUMMARY

j = Cursor Down 1 Character
h = Cursor Left 1 Character
k = Cursor Up 1 Character
l = Cursor Right 1 Character

0 = Cursor to Line Beginning




Type B to review material
Press ESC to return to menu
Press return key to continue
```

```
      SUMMARY

w,W = Forward to Beginning
      of Next Word
b,B = Backward to Beginning
      of Previous Word
e,E = Forward to End of Next
      Word

LOWER CASE COUNT PUNCTUATION
  AS WORDS

Type B to review material
Press ESC to return to menu
Press return key to continue
```

*** BRANCH BACK TO BASIC TOPICS ***

AUDIO ONE

Narrator: This section presented the commands for cursor movement. The first series of commands were for positioning the cursor in a file.

Narrator: The next set of commands provided the capability to move the cursor through the file a character at a time. A zero placed the cursor at the beginning of the line.

Narrator: The last set of commands were for positioning the cursor at the begining of a word by jumping forward or backward, or positioning the cursor at the end of a word by jumping forward only. Lower case commands treated punctuation marks as separate words while upper case ignored punctuation.

*** BRANCH BACK TO BASIC TOPICS ***

PICTURE	ALPHANUMERICS
Still frame of several file folders neatly spread with arrow curving up out of the top down to a file cabinet	Saving Files Type B to review material Press ESC to return to menu Press return key to continue
Video sequence of finger pressing escape key on Sun keyboard and a colon appearing in the lower left corner of screen	: = Ready to Receive Command Colon will appear in lower left corner of screen Type B to review material Press ESC to return to menu Press return key to continue
Video sequence of user pressing appropriate keys followed by screen showing results.	ZZ = Save File and Exit vi Type B to review material Press ESC to return to menu Press return key to continue

AUDIO ONE

Narrator: In this section, you will learn how to save your files.

Narrator: In vi, there are two basic ways to save files. One method requires that you first use the colon key to get the machine's attention. You will know you have its attention when a colon appears in the lower left corner. This means that the Sun Workstation is ready for a colon command.

Narrator: The first method, typing two capital Z's, is used to save a new file or to save changes made to an existing file. The file is saved under the same filename you used when you invoked vi.

PICTURE

Video sequence of user pressing appropriate keys followed by screen showing results.

ALPHANUMERICS

:q! <RET> = Exit vi
Without
Saving

Type B to review material
Press ESC to return to menu
Press return key to continue

SUMMARY

ZZ = Save File and
Exit

:q! <RET> = Exit vi
Without
Saving

ESC = Escape
Colon will appear in lower left corner of screen

Type B to review material
Press ESC to return to menu
Press return key to continue

*** BRANCH BACK TO BASIC TOPICS ***

Still photo of manuscript with portions of text marked out and insertions marked above deleted text

Inserting Text

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: If for any reason you wish to exit vi without saving any changes you might have made, use a lower case q followed by an exclamation point and a carriage return.

Narrator: This section has taught you how to save files and exit vi or just quit without changing by using a colon command. To execute a colon command, you must first press the colon key.

*** BRANCH BACK TO BASIC TOPICS ***

Narrator: This section will teach you how to insert text using six different commands. Before we show you the commands, there are two important things you should know. First, while you are inserting text, the arrow keys do not work. Second, the escape key is used to tell the editor that you are done with the current operation. Once you have pressed the escape key, the arrow keys will work again.

PICTURE	ALPHANUMERICS
Video sequence of user pressing appropriate keys followed by screen showing results.	i = Insert Text Before Cursor a = Insert Text After Cursor <ESC> Follows Entry of Text Type B to review material Press ESC to return to menu Press return key to continue
Video sequence of user pressing appropriate keys followed by screen showing results.	I = Insert Text in Front of Current Line A = Insert Text at End of Current Line Type B to review material Press ESC to return to menu Press return key to continue
Video sequence of user pressing appropriate keys followed by screen showing results.	o = Move Down 1 Line From Current Line and Add Text O = Move Up 1 Line From Current Line and Add Text <ESC> Follows Entry of Text Type B to review material Press ESC to return to menu Press return key to continue

AUDIO ONE

Narrator: To insert text before or after the cursor, use a lower case i or a. As you might guess, lower case i inserts and lower case a appends. To use these commands, position the cursor, type the letter for insert or append, then enter the text. When you are through, use the escape key to leave insert mode.

Narrator: To insert text at the beginning of the line without manually positioning the cursor, use an upper case I, followed by the text to be inserted. Then press the escape key. Likewise, an upper case A will append text at the end of the line.

Narrator: To begin the insertion of a line after the cursor line (in other words, to add a line below the cursor line), use a lower case o. To insert a line above the cursor line, use an upper case O.

PICTURE

ALPHANUMERIC

SUMMARY
i = Insert Text Before
Cursor
a = Insert Text After Cursor
I = Insert Text Before Line
A = Insert Text After Line
o = Move Down 1 Line and Add
Text
O = Move Up 1 Line and Add
Text
Type B to review material
Press ESC to return to menu
Press return key to continue

*** BRANCH BACK TO BASIC TOPICS ***

Still photo of manuscript with portions of text marked out (words mispelled by one letter and so on)

Deleting Characters

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of user pressing appropriate keys followed by screen showing results.

X = Delete Character
Preceding Cursor

nX = Delete n Characters
Preceding Cursor

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: This section showed you how to insert text before or after the cursor using lower case i or a; how to insert text at the beginning or end of a line without manually repositioning the cursor, by using upper case I or A; and how to insert a line above or below the cursor line by using lower and upper case O.

*** BRANCH BACK TO BASIC TOPICS ***

Narrator: This section will teach you how to delete a character or series of characters from a line.

Narrator: To delete the character just before the cursor, use an upper case X. To delete n characters just before the cursor, enter the number of characters to delete, followed by an upper case X.

PICTURE

Video sequence of user pressing appropriate keys followed by screen showing results.

```
 ALPHANUMERICS

x = Delete at Cursor

nx = Delete n Characters
       Starting at Cursor






Type B to review material
Press ESC to return to menu
Press return key to continue
```

```
      SUMMARY

X = Delete Character Before
      Cursor
nX = Delete n Characters
       Before Cursor
x = Delete Character at
      Cursor
nx = Delete n Characters
       Starting at Cursor




Type B to review material
Press ESC to return to menu
Press return key to continue
```

*** BRANCH BACK TO BASIC TOPICS ***

Video sequence of pencil erasing a mistake

```
Undo












Type B to review material
Press ESC to return to menu
Press return key to continue
```

AUDIO ONE

Narrator: To delete the character at the cursor, use a lower case x. To delete n characters starting at the cursor, enter the number of characters to delete followed by a lower case x.

Narrator: This section has taught you how to delete characters before or at the cursor. Upper and lower case X will be useful later with other commands.

*** BRANCH BACK TO BASIC TOPICS ***

Narrator: The undo command is possibly the most useful command for any user no matter what his or her level of experience.

PICTURE

Video sequence of user pressing appropriate keys followed by screen showing results.

ALPHANUMERICS

u = Delete Latest Change
Made

U = Delete All Changes
on Current Line

Type B to review material
Press ESC to return to menu
Press return key to continue

SUMMARY

u = Delete Only Last Change

U = Delete All Changes on
Current Line

Type B to review material
Press ESC to return to menu
Press return key to continue

*** BRANCH BACK TO BASIC TOPICS ***

Video sequence of stairs with bottom step labeled "Beginner", middle step labeled "Intermediate", and top step labeled "Advanced". Show person climbing up from bottom to middle.

INTERMEDIATE TOPICS

1. More on Saving Files
2. Joining Lines
3. Searching for a String
4. Finding and Replacing
5. Returning to Last Line Modified
6. Intermediate Cursor Control
7. Help
8. Test
9. Return to Main Menu

*** BRANCH TO SELECTION ***

AUDIO ONE

Narrator: A lower case u will undo, or delete, the last change, no matter where it occurred. An upper case U undoes all the changes on the current line. Once you move the cursor off the line, an upper case U will not work.

Narrator: To review, an upper case U undoes all the changes on the current line and a lower case u undoes only the last change, no matter where it occurred.

*** BRANCH BACK TO BASIC TOPICS ***

Narrator: To learn about intermediate topics in vi, position the cursor next to the topic of your choice and press the return key.

*** BRANCH TO SELECTION ***

PICTURE

Still photo of several file folders neatly spread with arrow curving up out of the top down to a file cabinet

ALPHANUMERICS

More on Saving Files

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of user pressing appropriate keys followed by screen showing results.

:w <RET> = Save File without
Exiting vi

Remember, a colon will appear on screen in lower left corner

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of user pressing appropriate keys followed by screen showing results.

:w<filename><filetype>
<RET> = Save File under
<filename>

<filetype> is optional.

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: In this section, you will learn how to save files without exiting the text editor. You will also learn how to copy one file into another.

Narrator: The commands used are called colon commands. To enter a colon command, remember you first must press the colon key. In order to save a file without exiting the editor, you use a lower case w, followed by a return. The file will be saved under the same name as was used when vi was invoked.

Narrator: To write the file you are editing into another file, use a lower case w, followed by the filename and optional filetype of the file you wish to write into.

PICTURE

ALPHANUMERICS

SUMMARY

:w <RET> = Save File Without
Exiting vi

:w<filename><filetype>
<RET> = Save File Under
<filename>
<filetype> is optional

Type B to review material
Press ESC to return to menu
Press return key to continue

*** BRANCH BACK TO INTERMEDIATE TOPICS ***

Video sequence of user pressing appropriate keys followed by screen showing results.

Joining Lines

J = Join 2 Lines Together

Type B to review material
Press ESC to return to menu
Press return key to continue

SUMMARY

J = Join 2 Lines Together

Type B to review material
Press ESC to return to menu
Press return key to continue

*** BRANCH BACK TO INTERMEDIATE TOPICS ***

AUDIO ONE

Narrator: To summarize, you have just been taught two additional methods for saving files. Both are colon commands which make use of the colon key and lower case w. Now you can save files without exiting the text editor and write one file into another.

*** BRANCH BACK TO INTERMEDIATE TOPICS ***

Narrator: This section will teach you a very simple concept--that of joining lines. An upper case J will make two lines into a single line. Simply position the cursor on the first of the two lines you wish to join and type an upper case J.

Narrator: This section has taught you how to join two lines into a single line. To use the join command, you position the cursor on the first of the two lines to be joined, then type an upper case J.

*** BRANCH BACK TO INTERMEDIATE TOPICS ***

PICTURE

Still photo of Officer of the Deck on a ship's bridge wing searching horizon with binoculars

ALPHANUMERICS

Searching for Strings

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of user pressing appropriate keys followed by screen showing results.

```
/  string  / <RET> = Search
         Forward for String
         of Characters

?  string  ? <RET> = Search
         Backward for String
         of Characters
```

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of user pressing appropriate keys followed by screen showing results.

```
// <RET> = Repeat Forward
             Search
?? <RET> = Repeat Backward
             Search

n = Perform Search Again in
      Same Direction
N = Perform Search Again in
      Opposite Direction
```

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: In this section, you will learn several methods of searching for strings (or words). This information is handy to know when you want to find a misspelled word.

Narrator: To search forward for a string, type a slash followed by the string, followed by another slash and a return. If the string is found, the cursor will appear under the first character of the string. If the string is not found, the message "Pattern not found" will appear at the bottom of the screen. During the searching process, the string you type between the two slashes will appear on the bottom of the screen. To search backward, replace the slashes with question marks.

Narrator: There are a couple of methods of continuing to search for a string. If you enter a pair of slashes or question marks with nothing in between, the original string will be searched for. In other words, they act as if you had typed that string again. Typing a lower case n will have the same effect as typing a pair of slashes or question marks without the string. That is, a lower case n will search in the same direction for the next occurrence of the string. An upper case N will reverse the direction of the search.

PICTURE

Video sequence of user pressing appropriate keys followed by screen showing results.

ALPHANUMERICS

/ ^ string / <RET> =
Search Forward for String
at Beginning of a Line

? ^ string ? <RET> =
Search Backward for String
at End of a Line

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of user pressing appropriate keys followed by screen showing results.

/ string $ / <RET> =
Search Forward for String
at Beginning of a Line

? string $ / <RET> =
Search Backward for String
at End of a Line

Type B to review material
Press ESC to return to menu
Press return key to continue

SUMMARY

/ string / <RET> = Forward Search
// <RET> = Repeat Forward Search
/ ^ string / <RET> = Search Forward for String at Beginning of Line
/ string $ / <RET> = Search Forward for String at End of Line

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: To search forward of backward for a string at the beginning of a line, precede the string with a caret, or up arrow at it is frequently called. When the up arrow is the first character of a search string, it tells the editor to search for the string at the beginning of the line.

Narrator: When a dollar sign is the last character of the search string, the editor searches for the string at the end of the line. This gives us the capability to search forward or backward for a string at the end of a line. All four commands are useful when there are several occurrences of the same string.

Narrator: This section has taught you how to search forward and backward for a string, how to continue searching for a string, and how to search for a string at the beginning or end of a line. The commands shown here are all for searching forward.

PICTURE

ALPHANUMERICS

SUMMARY

? string ? <RET> = Backward Search
?? <RET> = Repeat Backward Search
? ^ string ? <RET> = Search Backward for String at Beginning of a Line
? string $? <RET> = Search Backward for String at End of a Line
Press B, ESC, or return

SUMMARY

n = Repeat Search in Same Direction
N = Repeat Search in Opposite Direction

Type B to review material
Press ESC to return to menu
Press return key to continue

*** BRANCH BACK TO INTERMEDIATE TOPICS ***

Still photo of manuscript with deletions marked

Finding and Replacing Characters

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: The commands shown here are all for searching backward. Remember, a caret causes the editor to search for the string at the beginning of a line and a dollar sign causes the editor to search for the string at the end of a line.

Narrator: These commands will repeat any search. Lower case n repeats the search in the same direction, and upper case N repeats the search in the opposite direction.

*** BRANCH BACK TO INTERMEDIATE TOPICS ***

Narrator: This section will teach you how to find and replace characters.

PICTURE

Video sequence of user pressing appropriate keys followed by screen showing results.

ALPHANUMERICS

f <c> = Find Character <c>.
on Current Line by
Searching Forward

F <c> = Find Character <c>
on Current Line by
Searching Backward

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of user pressing appropriate keys followed by screen showing results.

r <c> = Replace Character at
Cursor with
Character <c>

s <cc> = Substitute Character at Cursor with
Characters <cc>.
End Sequence of
Characters with
<ESC>.

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of user pressing appropriate keys followed by screen showing results.

R <c> = Replace Character at
Cursor until <ESC>
Key is Pressed.
Cursor Moves Right
with Each Character
Entered.

S = Substitutes a Whole
Line at a Time

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: To find a specific character on the current line by searching forward, type a lower case f followed by the character you wish to find. To search backward on the current line for a specific character, use an upper case F.

Narrator: Once you have used either of the F commands to place the cursor on the character you wish to replace or substitute, you can use the lower case r or s command. If you want to replace one character with another, type a lower case r followed by the replacement character. If you want to substitute more than one character for a single character, type a lower case s followed by the replacement characters. To end this command, you must use the escape key. The difference between the lower case r and s commands is that r replaces the current character while s substitutes the current character with a string which is terminated by pressing the escape key.

Narrator: The upper case version of replace, or r, replaces each character one at a time until you press the escape key. The upper case version of substitute, or s, substitutes the whole line.

PICTURE

```
 ALPHANUMERICS

          SUMMARY

f <c> = Find Character <c>
        on Current Line by
        Searching Forward

F <c> = Find Character <c>
        on Current Line by
        Searching Backward

Type B to review material
Press ESC to return to menu
Press return key to continue
```

```
          SUMMARY

r <c> = Replace Character at
        Cursor with
        Character <c>

s <cc> = Substitute Charac-
         ter at Cursor with
         Characters <cc>
         Press <ESC> to
         Terminate Command

Type B to review material
Press ESC to return to menu
Press return key to continue
```

```
          SUMMARY

R <c> = Replace Character at
        Cursor Until <ESC>
        Key is Pressed.
        Cursor Moves Right
        With each Character
        Entered.

S = Substitute a Whole Line
    At a Time

Type B to review material
Press ESC to return to menu
Press return key to continue
```

*** BRANCH BACK TO INTERMEDIATE TOPICS ***

AUDIO ONE

Narrator: This section gave you several methods to find and replace characters. A lower case f searches forward on the current line for a specific character while an upper case F searches backward

Narrator: A lower case r replaces the current character with another character while a lower case s substitutes the current character with a string.

Narrator: An upper case R replaces each character one at a time while an upper case S substitutes the whole line.

*** BRANCH BACK TO INTERMEDIATE TOPICS ***

PICTURE

Video sequence of user pressing appropriate keys followed by screen showing results.

ALPHANUMERICS

Return to Last Line Modified

’ ’ = Return to Last
Modified Line

‘ ‘ = Return to Last
Character Modified

Type B to review material
Press ESC to return to menu
Press return key to continue

’ ’ = Return to Last
Modified Line

‘ ‘ = Return to Last
Character Modified

Type B to review material
Press ESC to return to menu
Press return key to continue

*** BRANCH BACK TO INTERMEDIATE TOPICS ***

Video sequence of flashing cursor

Intermediate Cursor Control

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: To return to the last line modified, use a pair of apostrophes. The inverse of this is to use a pair of reverse apostrophes which take you to the exact character last modified, not just to the line.

Narrator: This section has shown you how to get to the last line modified. There are two ways to do this. The first will place the cursor on the line modified. This is done by typing two apostrophes. The second method places the cursor on the exact character that was last modified. This method is accessed by typing two reverse apostrophes.

*** BRANCH BACK TO INTERMEDIATE TOPICS ***

Narrator: This section will teach you more about cursor control. These commands are complementary to the previous cursor commands you have learned.

PICTURE

Video sequence of user pressing appropriate keys followed by screen showing results.

ALPHANUMERICS

nn G = Move Cursor to Line
nn

nn | = Move Cursor to
Column nn on Current
Line

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of user pressing appropriate keys followed by screen showing results.

m <x> = Mark the Location of
the Cursor and Name
it <x>

' <x> = Move Cursor to
Location Named <x>

Type B to review material
Press ESC to return to menu
Press return key to continue

SUMMARY

nn G = Move to Line nn
nn | = Move to Column nn
m <x> = Mark Cursor Location
and Name it <x>
' <x> = Move Cursor to
Location named <x>

Type B to review material
Press ESC to return to menu
Press return key to continue

*** BRANCH BACK TO INTERMEDIATE TOPICS ***

AUDIO ONE

Narrator: To move to any line within the file, type the number of the line you wish to examine, followed by an upper case G. To move the cursor to a specific column within the current line, type the number of the column followed by a vertical bar.

Narrator: Sometimes it is necessary, in the midst of editing a file, to examine another part of the file. You are then faced with remembering your place in the file, looking at the text, and then getting back to your original location. vi has a mark command, lower case m. Simply type a lower case m followed by the lower case character you wish to use to name the location. To return to your original location once you are done examining text elsewhere in the file, type an apostrophe followed by the lower case character you marked your location with.

Narrator: This section has shown you how to move the cursor to any line within a file and how to move the cursor to any column within the current line. You have also learned how to mark your location and return to it. Remember, only lower case characters can be used to mark a location.

*** BRANCH BACK TO INTERMEDIATE TOPICS ***

PICTURE

Video sequence of set of stairs with bottom step labeled "Beginner", middle step labeled "Intermediate", and top step labeled "Advanced". Show person climbing up to top step.

```
ALPHANUMERICS

      Advanced Topics

1. More on Low-level
   Character Manipulation
2. Advanced Correction
3. Text Buffers
4. Advanced Substitution
5. More on Inserting Text
6. Abbreviations
7. Help
8. Test
9. Return to Main Menu
```

*** BRANCH TO SELECTION ***

Video sequence of user pressing appropriate keys followed by screen showing results.

```
More on Low-level Character
  Manipulation

t <c> = Search Forward to
        Character <c> and
        Place Cursor on Pre-
        ceding Character

T <c> = Search Backward to
        Character <c> and
        Place Cursor on Pre-
        ceding Character

Type B to review material
Press ESC to return to menu
Press return key to continue
```

```
       SUMMARY

t <c> = Search Forward to
        Character <c> and
        Place Cursor on Pre-
        ceding Character

T <c> = Search Backward to
        Character <c> and
        Place Cursor on Pre-
        ceding Character

Type B to review material
Press ESC to return to menu
Press return key to continue
```

*** BRANCH BACK TO ADVANCED TOPICS ***

AUDIO ONE

Narrator: Position the cursor next to the topic of your choice and press the return key.

Narrator: In an earlier section, you learned how to search forward or backward for a specific character. Those commands placed the cursor under the specified character. To place the cursor on the character immediately preceding the specified character, type a lower case t followed by the character. A lower case t searches forward and an upper case T searches backward.

Narrator: This section showed you how to search forward or backward for a character and place the cursor under the character immediately preceding it. A lower case t searches forward and an upper case T searches backward.

*** BRANCH BACK TO ADVANCED TOPICS ***

PICTURE

Still photo of manuscript
with corrections indicated

ALPHANUMERICS

Advanced Correction

Type B to review material
Press ESC to return to menu
Press return key to continue

c<object specification>
<replacement object><ESC>=
Replace <object specifica-
tion> with <replacement
object>

Object specifications are
commands such as w,W,b,B,^,$

Type B to review material
Press ESC to return to menu
Press return key to continue

EXAMPLE

Euclid alone has looked
upon beauty bear.

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: In this section, you will learn about advanced correction using advanced correction operators. They are perhaps two of the most powerful operators in vi.

Narrator: The lower case d and c are called operators instead of commands because they consist of three parts: a count specification or a buffer specification, the d or c, and the object or range description. One such object or range specification is w--for word. If you type a lower case cw, followed by the word you are changing to and and escape, vi will change the word. Buffers are temporary storage locations use to store data, in this case text. They are described in detail in the section on text buffers.

Narrator: For example, in this sentence, the word bear isn't the right one. We will use the c operator to make it right.

PICTURE

ALPHANUMERICS

COMMAND

2fbcwbare<ESC>

2fb = search forward for
      second occurrence of b
cwbare = change word
         starting at cursor
         to "bare"

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of user pressing appropriate keys followed by screen showing results.

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of user pressing appropriate keys followed by screen showing results.

d <object specification> =
   delete <object specification>

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: This is the command that will fix it. The number 2 before the f operator will cause the editor to search for the second occurrence of the letter. "cwbare" tells the editor to change the word starting at the cursor to "bare".

Narrator: Now watch the editor perform the operation.

Narrator: Now that you know how the change operator works, we will show you how to use the delete operator, lower case d. Any command which uses the d operator takes the same format as for the c operator. Once you have placed the cursor, a dw will delete the word beginning at the cursor. A dd will deleted the entire line. If you mistakenly delete something, you can retrieve it from the unnamed buffer. For more information, study the section on text buffers.

PICTURE

ALPHANUMERICS

SUMMARY

c = change

d = delete

Type B to review material
Press ESC to return to menu
Press return key to continue

*** BRANCH BACK TO ADVANCED TOPICS ***

Still photo of collection of filing cabinets with label "Temporary" diagonally across photo. Label is flashing.

Text Buffers

Buffer = Temporary Text
Storage Location

Type B to review material
Press ESC to return to menu
Press return key to continue

1 Buffer (unnamed) is filled each time delete commands are used

Commands are:

c = change   r = replace
d = delete   x = delete
s = substitute   X = delete

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: In this section, you learned how the change and delete operators work. You can put another move-the-cursor command after the lower case c or d to specify a range over which the command will be effective.

*** BRANCH BACK TO ADVANCED TOPICS ***

Narrator: This section will teach you the basics of text buffers and their use. vi gives you the ability to store text away in buffers. This feature is very convenient for moving text around in your file. A buffer is a temporary storage location for data such as text.

Narrator: There are a total of thirty-five buffers available in vi. There is the unnamed buffer that is used by all commands that delete text. These commands are the change operator, the substitute and replace commands, the delete operator, and delete command. The unnamed buffer is filled each time any of these commands are used.

PICTURE

Still photo of collection of file cabinets with label "Temporary" diagonally across photo. Label is flashing.

ALPHANUMERICS

26 Buffers (Named a-z)
(a ... z)

"cdd = Delete Current Line and Store in "c"

"Cdd = Delete Current Line and Append to Contents of "c"

Type B to review material
Press ESC to return to menu
Press return key to continue

Still photo of collection of file cabinets with label "Temporary" diagonally across photo. Label is flashing.

9 Buffers (1 ... 9)

Used to Store the Last Nine Deletions. The unnamed Buffer is the First of These.

Type B to review material
Press ESC to return to menu
Press return key to continue

" <lettered buffer name> =

References the Named Buffer

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: There are twenty six buffers named a through z which are available to the user. If the name of the buffer is capitalized, then the buffer is not overwritten but is appended to.

Narrator: Finally, there are nine buffers named 1 through 9 in which the last nine deletes are stored. Buffer 1 is the default buffer for the modify commands and is sometimes called the unnamed buffer.

Narrator: To reference a specific buffer, use a druble quote followed by the name of the buffer.

PICTURE

Video sequence of user pressing appropriate keys followed by screen showing results.

ALPHANUMERICS

p = Retrieve Line from
    unnamed Buffer and Place
    at Cursor

P = Retrieve Line from
    unnamed Buffer and Place
    Before Cursor

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of user pressing appropriate keys followed by screen showing results.

" <c> p = Put the Contents
          of Buffer Named
          <c> at Cursor

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of user pressing appropriate keys followed by screen showing results.

Steps in a Block Move

1. Place Cursor at Beginning of Paragraph
2. Type "gd
3. Move Cursor to Next Line
4. Type "Gd (Appends)
5. Repeat step 4 as desired
6. Move Cursor to Desired Location
7. Type "gp

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: If two lines of text are reversed, the unnamed buffer can be used to put things right. You would place the cursor on the line you wish to move and type a pair of lower case d's. Then move the cursor to where you want the line and type a lower case p. The p command retrieves the line from the unnamed buffer. An upper case P will also retrieve the line from the unnamed buffer, but it places the line before the cursor.

Narrator: The P commands also can be used with the named buffers. A literal translation of this command is, "Put the contents of the buffer named <c> at the cursor."

Narrator: The use of the capability to append lines to a buffer gives you the ability to do block movement of entire paragraphs or segments. In this example, we will use the buffer named g. The first step is to position the cursor on the first line we want moved, then type a double quote followed by the name of the buffer, lower case g, then a pair of lower case d's to delete the line. The third step is to move the cursor to the next line and again type a double quote followed by the name of the buffer, but this time using an upper case G since we want to append the line. Proceed in this fashion until the whole paragraph is in the buffer. Then move the cursor to the location you want the text placed and type a double quote followed by a lower case g and an upper or lower case P.

PICTURE

ALPHANUMERICS

SUMMARY

Buffer = Temporary Storage Location

" <a ... z> = Reference to Named Buffer

"<a ... z>p = Put Contents of Named Buffer at Cursor

"<a ... z>P = Put Contents of Named Buffer before Cursor

Type B to review material
Press ESC to return to menu
Press return key to continue

*** BRANCH BACK TO ADVANCED TOPICS ***

Still photo of manuscript with word crossed out and substitute word written above.

Advanced Substitution

:s

Type B to review material
Press ESC to return to menu
Press return key to continue

Video sequence of user pressing appropriate keys followed by screen showing results.

:s / old string / new string / <RET> = Search for Old String and Replace with New String

Remember, a Colon will Appear on the Screen in the Lower Left Corner

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: This section has presented a great deal of complex information. You have been shown how to retrieve and store lines of text in buffers in order to reorganize sentences and how to use the append capability to carry out a block move. If you are still not sure you understand the material, please review it.

*** BRANCH BACK TO ADVANCED TOPICS ***

Narrator: This section will teach you how to make advanced substitutions using another colon command, colon s.

Narrator: To enter this command, you must first press the colon key, then a lower case s. Immediately after the s, you type a slash, followed by the search pattern. Then type another slash, followed by the replacement pattern and another slash. Last, type a return to make vi carry out the command. It will search the current line for the search pattern and replace it with the replacement pattern.

PICTURE

Video sequence of user pressing appropriate keys followed by screen showing results.

ALPHANUMERICS

:g / old string / s //
  new string / <RET> =
  Global Search for Old
  String and Replace with
  New String

Global = in the Entire File

Type B to review material
Press ESC to return to menu
Press return key to continue

SUMMARY

:s / old string /
  new string / <RET> =
  Search for Old String and
  Replace with New String
:g / old string/ s //
  new string / <RET> =
  Global Search for Old
  String and Replace with
  New String

Type B to review material
Press ESC to return to menu
Press return key to continue

*** BRANCH BACK TO ADVANCED TOPICS ***

Still photo of manuscript with a caret and word to insert

More About Inserting Text

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: If you want to use the colon s command for a global, or file-wide, search and replace, you would place a lower case g at the start of the command string. This is followed by a slash, the string you want to replace, and another slash. Then you type a lower case s followed by two slashes with nothing in between. This is because the lower case g marks the search pattern in all lines. After the two slashes, type the replacement string followed by another slash and the return key.

Narrator: This section taught you how to use another colon command to perform advance substitutions. When the colon s is preceded by the global, or lower case g, command, you can replace a string throughout the file.

*** BRANCH BACK TO ADVANCED TOPICS ***

Narrator: This section will teach you a few shortcuts about inserting text.

PICTURE

ALPHANUMERICS

<CTRL> H = Delete Last
Input Character
<CTRL> W = Delete Last
Input Word
<CTRL> U = Delete all Input
on Current Line
<ESC> = Terminate Insert
Mode

Type B to review material
Press ESC to return to menu
Press return key to continue

SUMMARY

<CTRL> H = Delete Last
Input Character
<CTRL> W = Delete Last
Input Word
<CTRL> U = Delete all Input
on Current Line
<ESC> = Terminate Insert
Mode

Type B to review material
Press ESC to return to menu
Press return key to continue

*** BRANCH BACK TO ADVANCED TOPICS ***

Still photo of entrance to
Naval Postgraduate School
with characters NPS super-
imposed beneath sign

Abbreviations

Type B to review material
Press ESC to return to menu
Press return key to continue

AUDIO ONE

Narrator: There are a number of characters which you can use to make corrections while you are in input mode. A control H deletes the last input character. A control W deletes the last input word. A control U deletes the input on the current line. And, as a reminder, the escape key terminates input mode.

Narrator: This section has taught you a few shortcuts to using the text editor.

*** BRANCH BACK TO ADVANCED TOPICS ***

Narrator: This section discusses the abbreviation command.

PICTURE

Video sequence of user pressing appropriate keys followed by screen showing results.

ALPHANUMERICS

:ab <abbreviation> < >
<long version> <RET> =
Substitute <long version>
for <abbreviation>
Whenever <abbreviation> is
typed

Note that a Space is Typed
Between Abbreviation and
Long Version
Type B to review material
Press ESC to return to menu
Press return key to continue

SUMMARY

:ab <abbreviation> < >
<long version> <RET> =
Substitute <long version>
for <abbreviation>
Whenever <abbreviation> is
Typed

Type B to review material
Press ESC to return to menu
Press return key to continue

*** BRANCH BACK TO ADVANCED TOPICS ***

AUDIO ONE

Narrator: When typing large documents, you may find yourself typing a large phrase over and over. vi gives you the ability to specify an abbreviation for a long string such that typing the abbreviation will automatically expand into the longer phrase. The format of the command is shown. This colon command uses the first two occurrences of a blank to set off the abbreviation. The second blank is followed by the longer phrase. When it's all entered, type a return. Then any time you type the abbreviation in the file, vi will expand it into the longer phrase.

Narrator: The abbreviation command, colon ab, gives you a great deal of flexibility in entering long phrases frequently within a file.

*** BRANCH BACK TO ADVANCED TOPICS ***

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